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RACIAL DIFFERENCES IN PALM AND SOLE CONFIGURATION

By HARRIS HAWTHORNE WILDER

INTRODUCTION

A comparatively small number of investigators have interested themselves in the epidermic markings on the volar surface of the human hand and foot, and of these but two have suggested in them a possible ethnographic value. The first was Arthur Kollmann, ('83 and '85)¹ who made use of all the opportunities afforded him and studied the actual palm and sole surfaces of numerous representatives of various races. He did not employ, and probably did not know, the method of printing the surfaces, and studying these impressions instead of the actual objects, and his observations were thus not only extremely difficult to make, but impossible to record more than in a general way; in addition to which came the greatest disadvantage of all — that of not being able to study a large enough number of individuals of any given race to eliminate the individual variation. Thus, in the comparison of hands, his list included two Chinese; two Japanese; two Turks; three Armenians; three native Australians, then on exhibition in Berlin; two African negroes, both with white blood; and six negroes from America. In the investigation of soles he fared better, making use of several traveling troupes on exhibition in Berlin, although by this means he must have studied in each case closely related individuals, and thus have been liable to have taken merely family characteristics for those of racial value. Here his list included 21 Ceylonese, 21 Kalmucks, 1 Armenian, 1 Australian, a number of African and several American negroes, and several Araucanians from Chile.

Although in this latter case, that of the feet, Kollmann possessed material enough for some results, had he employed prints and had he selected unrelated individuals, his standpoint was not

¹ See the Bibliography at the close of the article.

quite right for the production of definite results, since in the first place he studied patterns alone and had no knowledge of main lines, triradii, and other essential features, and in the second, his main endeavor was to find Simian characteristics in the lower races, a condition which he thought *a priori* probable. In this he came to no definite results.

The other investigator along this line was Francis Galton ('92) who, as in all his work, confined his comparison to the finger-tips. His results also were indefinite.

Aside from these two investigators it should be mentioned that Hepburn ('95) investigated the feet of a dead negro, and speaks as though he had had other cases under observation. In these he finds nothing, however, which he could not have seen equally well in members of his own race.

The present paper is the result of the suggestion made by me a year and a half ago¹ that "it would be of much interest to compare the sculpture of the palms and soles in the various races of men, as it is at least possible that *there may be sufficient difference to constitute important racial characteristics.*"

As the method of treatment of this subject is largely by the employment of descriptive formulæ, and as information concerning these is in part scattered through various former papers of mine,² and in part has not yet been published, it seems best to begin this paper with a brief description of the essential features found in palms and soles, and with instruction concerning the method of writing descriptive formulæ expressive of the conditions found in individual cases.

I.—PALM AND SOLE CHARACTERS, AND THE METHOD OF RECORDING THEM BY MEANS OF DESCRIPTIVE FORMULÆ

The Palm. — The palmar configuration in man has become more modified than has the sole, and is thus simpler in its configuration,

¹ "Palms and Soles," *Amer. Jour. of Anatomy*, vol. 1, p. 434.

² Facsimile prints, marked by the main lines and other features, and showing both palms and soles, are given in *Amer. Jour. of Anatomy*, vol. 1, No. 4 (Sept., 1902), and in *Popular Science Monthly*, Sept., 1903. Two palms (Maya) and two soles (Negro), similarly marked, appear as plates X and XI of this article. These will be of much help in understanding the general description immediately following.

though secondarily so. The method employed in describing it has therefore only a remote relation to the original morphology of the parts, but seems well fitted to its actual condition.

In its interpretation the first points to be established are the *four digital triradii* situated below the bases of the four fingers. From each of these points three lines radiate which are to be followed on a print by means of pen or pencil as far as they may be followed without crossing any of the ridges. Of these three lines, the *radiants*, two of them pass upward between the fingers and serve merely to define small triangular *digital areas*, which in reality belong to the systems covering the volar surfaces of the fingers and have intruded themselves like small wedges upon the palm. The four remaining radiants, one from each digital triradius, traverse more or less of the palm, though with a great variety of possible relations and interrelations, and are termed the *four main lines*, since by locating these the general topography of a given palm is outlined. They are designated by the capital letters A–D, beginning on the inner or radial side. As their origins are from points relatively fixed in position, their courses can be expressed with sufficient accuracy by locating their termini, and this is readily done by means of the artificial numerical scheme shown in fig. 2, *a*, in which numbers are arbitrarily fixed to the various marginal points and interspaces in which these lines may terminate. The courses of the four main lines are thus designated by a formula consisting of four figures, the order being, for several reasons, the reverse of the usual one, beginning with line D, the fourth one, instead of A, the first. In rare cases, especially in line D, the main line meets a lower triradius, thus being prevented from reaching the margin at any point. When this occurs, the radiant forming the continuation of the main line is followed and its terminal number employed, thus reducing the condition to that of a normal line bearing a triradius at a given point along its course. The existence of the triradius is indicated in such cases by the use of a small *t* added as an exponent to the number. Examples of main line formulæ arranged in numerical sequence for ease in reference are shown in tables II and III.

Aside from the above, the conditions near the wrist should also be noted. Here, in perhaps the majority of cases, there is found a

well-defined *carpal triradius*, the presence of which is indicated by a C added as a fifth term to the main line formula ; but occasionally the lines of the ulnar and radial regions merely diverge, forming what may be considered the upper portion of an extra-limital triradius, or one which does not appear since its location would be on the normal skin beyond the limits of the ridges ; this condition is expressed in the formula by P, i. e., a "*parting*." Various modifications of these two conditions are easily expressed by means of Galton's device of "descriptive suffixes" in the form of exponents, many of which are used in table VI and explained just below it. See also the list of abbreviations, pages 253, 254.

Patterns in form similar to those of the finger tips may occur in several places, namely, on the *thenar* and *hypothenar* regions and on either of the three interspaces included between the main lines, the *three palmar areas*. Of these patterns the hypothenar, when present, has always a genuine morphological value, and is directly descended from one that is more constant in appearance in lower forms ; the thenar is really the equivalent of two, and is often indicated as such by being composed of two loops placed in opposite directions ; and the three palmar patterns may either be *true* (i. e. of morphological value), or *false* (i. e., of accidental occurrence). The former is always accompanied by an extra triradius called a *lower triradius*, which assists in its formation, but the latter is formed merely by the abrupt recurving of one of the main lines, and is without trace of triradius.¹

In formulation the hypothenar and the thenar are designated by H and θ respectively ; the three palmar patterns are designated by the numbers 1-3, and their nature is indicated either by an exponent, *l* for a loop, or false pattern, and *t* (triradius) for a true one ; or by the words "loop" and "triradius" as in table VII.

This brief description of palmar characters and their formulation is very incomplete and may be supplemented by my former papers on the subject, especially that in *Popular Science Monthly*, September, 1903.

¹ The distinction, although a practical one, may not in all cases be strictly true from a morphological standpoint, since it is conceivable that a true pattern may, through suppression of radiants, be practically without the characterizing lower triradius. For a fuller treatment of this matter see Miss Whipple, 1904.

The Sole. — There are many practical difficulties in the way of an attempt to formulate the sole by the method employed in the case of the palm, the principal ones being the following :

1. The more primitive character, and hence the greater complexity of the sole.

2. The frequent location of the digital triradii and other important features in the concavity between the ball of the foot and the balls of the toes, where printing cannot well be done.

3. The more frequent occurrence of large and important lower triradii, the radiants of which are extensive and enter into important relations with the main lines and other parts.

Of these difficulties the most serious is the second, which points out the incompleteness of an ordinary print, and urges the employment of a system which makes use of those parts always shown in a print, and which are not in any way dependent upon digital triradii or other features apt to be beyond the limit of a usual impression. As a series of designations of marginal and other topographical points may be occasionally needed, I have prepared for that purpose a sole-diagram comparable with that of the palm, and given above in connection with it (fig. 2, *b*). If one abandons the main lines as too uncertain in determination to be used as a starting-point, the most natural, because the most conspicuous and universal, character would be the *hallucal pattern*, that upon the raised eminence below the great toe. This feature can be seen with great ease, and with a little practice its type may be determined with accuracy upon the natural foot, thus making it a matter of the greatest convenience in such practical cases as the identification of burned or otherwise badly mutilated bodies. This is the most primitive pattern found in man and quite frequently exhibits the typical arrangement of ridges as seen in fig. 3, *a*. This is the primitive whorl type, and shows for its core a succession of concentric circles, which are frequently very perfect. This core, which is often quite extensive in area, is bounded externally by three triradii, each embracing the core with two of its radiants like a capital Y, while the third radiant, known as the *divergent*, extends directly away from the center of the pattern. In conformity with other mammalian patterns, the three triradii are designated as the *outer*

(a), the *inner* (b), and the *lower* (c), but it must be remembered that *these terms refer to these positions relative to the entire foot rather than to the print*, and that they are applied in conformity with a general

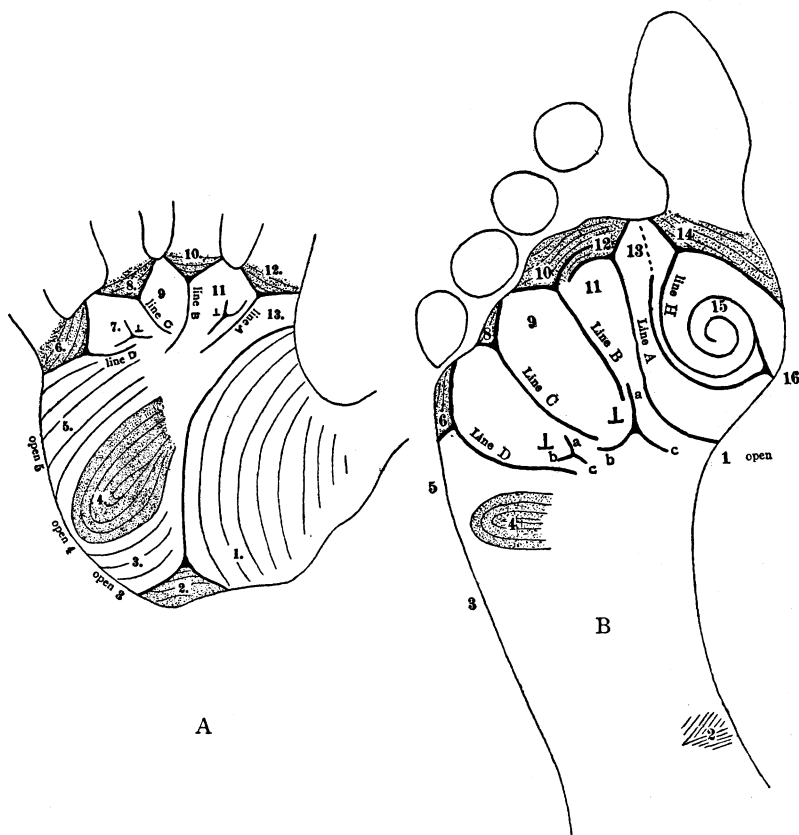


FIG. 2.—Diagrams of human palm and sole, to illustrate the method of designating individual conditions by means of descriptive formulæ. (From *Popular Science Monthly*, Sept., 1903 ; by permission.)

morphological principle rather than with reference to this especial place. It will be easier to remember these as *a*, *b*, and *c* respectively, designations which will be seen to have a meaning in the system here proposed.

Such a typical pattern as the one given in fig. 3, *a*, is termed a *whorl*, and designated in a formula as W, but there may be various

modifications of this. Of these the commonest is the suppression of the divergent of triradius c which gives the entire pattern a rounded aspect on its outer border. Such a condition may be designated as W^d . In like manner we may express a reduction (not a loss) of either of the other triradii as W^a and W^b , the first of which is not uncommon. Lastly, the core may become modified as a spiral (very common in the white race) or as an S-shaped

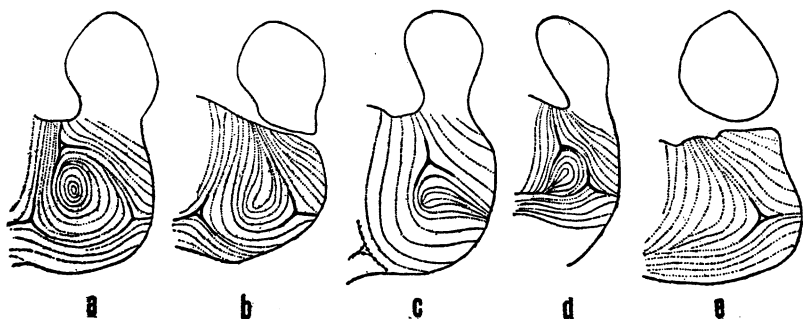


FIG. 3.—Types of hallux patterns; tracings from actual cases. Two-fifths natural size. *a*, Cat. No. 338, Maya; primitive type, embraced by three triradii. *b*, Cat. No. 337, Maya; type A, pattern opens through outer (upper) triradius. *c*, Cat. No. 301, Chinese (right reversed), type B, pattern opens through inner triradius. *d*, Cat. No. 58, white; type C, pattern opens through lower triradius. *e*, Cat. No. 338, Maya (right reversed); type AC, pattern opens by both outer and lower triradii.

figure, and these conditions are designated by the exponents sp . and s . respectively, either with or without other exponents. Thus we may have W^s , W^{ds} , W^{asp} , etc.

This typical pattern often degenerates through the loss of one or more of its triradii, and the consequent opening up of its ridges in the direction of the missing triradius. A triradius may simply suffer the obliteration of its divergent, as frequently in the case of triradius c , without allowing the pattern to open; but if really gone, the ridges, no longer enclosed by the embracing radiants, will, as it were, gush forth to the margin of the print. There are, of course, three main types of these, easily designated by the capital letters A, B, and C, to correspond with the triradii which have given way (fig. 3, *b-d*), but occasionally a pattern may open at two of these points, thus making the rather unusual conditions of AB, AC, or

BC. These various conditions, although they may be laborious to describe, are readily understood when first seen, and easily recognized afterward. Where the filing and cataloguing of a large number of sole-prints becomes a necessity, as in an identification bureau, it is recommended that the type of hallucal pattern be made the first term in the formula, a logical sequence of which may easily be made, the symbols being arranged in alphabetical order and subdivided by their exponents.

The further description of the sole is best made by studying the various conditions of the three plantar areas, corresponding to the three palmar areas of the hand, and although the four main lines which delimit and designate these may usually be made out, a little practice will enable one to locate the areas with considerable precision even without this aid, and in cases where no digital tri-radii appear on the print. This plan is similar to the one first suggested by me for use in the case of the palm (1902 b) and differs from the method now employed and described above mainly in laying the emphasis upon the areas themselves, their interrelations and their patterns, rather than upon the lines which bound them.

In describing a plantar area the number of characters to be expressed is not large, and the principal varieties, together with the abbreviations recommended for use in descriptive formulæ, are the following :

1. *An open area*, i. e., one whose ridges reach the margin of the print. Of these there are two possible forms, one in which the opening is upon the inner margin (O) and one in which the opening is to the outer margin (5). The first is very common, the second rare. A narrow opening, that is, one consisting of a few ridges only, is expressed by Oⁿ.

2. *A closed area*, i. e., one whose ridges do not reach either margin, being stopped or turned back by some other formation. This latter may be either another area which curves around its lower end, or a lower tri-radius which embraces the area with two of its radiants. The symbol for a closed area is Cl and the agency of a tri-radius is expressed by an exponent t. Aside from the usual form of the lower end of a closed area, which is that of a rounding curve, there sometimes occurs the form expressed as Cl^v, in which the area comes to a sharp point; also the form Cl^f, somewhat like the last but with the point more prolonged and curved around an adjacent area.

3. *Confluent areas*, or where the ridges are continuous from one to another. This is designated by a + sign followed by a number designating the area with which it is confluent. Thus + 1, applied to area 2 or area 3, would mean that the ridges of the area in question curve or flow around into the territory of area 1, and so on. A confluence is seldom complete for either area involved, and still more rarely mutually so. In such cases, those of *semi-confluent* areas, the condition is expressed by two or more symbols expressive of the course of the various ridges, or rather, groups of ridges, always beginning with those nearest the great toe (inner or tibial side). Thus, in designating area 2, the expression Cl¹ + 3 would signify that a part of its ridges, those nearest the inner side, were enclosed by the radiants of a lower triradius, and that the remainder were confluent with area 3.

4. *An area looped above*. — This occurs most frequently in the case of area 1, although not unknown in the others, and consists of a series of curved ridges which define the upper border of the area. This condition, formulated as L, and added to the other designations of the area, is produced by a downward curve of one or both of the digital lines that lie adjacent to the patterns, which occasionally meet and form an arch, but more frequently pass one another, one of these running along the digital areas above the plantar areas, while the other curves downward and becomes involved with these latter in various complex relations.

The above set of symbols have proven fully adequate in the description of the 184 separate soles formulated in this paper, and it seems reasonable to suppose that the system will prove sufficient for all cases, at the most by the addition of a few exponents that will easily suggest themselves.

To the above formulæ may be added the symbol H to express a hypothenar pattern when present, and that of K to represent a *calcar*,¹ the very unusual pattern occurring on the heel. These may all be united into a single formula of six possible places, giving in order the conditions of (1) the hallucal area, (2-4) the three plantar areas, (5) the hypothenar, and (6) the calcar. The first practical use of this system is the one used in this paper and seen in tables VIII, IX, XVII, and XXII, below.

Aside from the sole characters above provided for, lower tri-

¹ The phonetic form of this symbol seems advisable in order to distinguish it from the C of the carpal area.

radii are of great morphological importance, but it has been thought best not to consider them save by a few descriptive exponents in formulating sole conditions. They receive some special attention farther on, under the description of Maya feet, where they assume special importance.

For the reader's convenience there follows here a list of the various symbols employed in the descriptive formulæ of palms and soles, together with their meaning; in most cases the use of the descriptive exponents is explained also in connection with the tables in which they are used.

CLASSIFIED LIST OF ABBREVIATIONS

I. — The Main Features

PALMS

Lines A–D. The four main lines.
 d_1 – d_4 . The four digital triradii.
 1–13. As applied to the main lines, these numbers express the point of termination. (See diagram, fig. 2, *a*.)
 C. Carpal triradius.
 P. Parting.
 H. Hypothenar pattern.
 θ . Thenar pattern.
 1–3. As used in the pattern formula, these numbers signify the three palmar patterns.
 \perp_1 – \perp_4 . A lower triradius; the small figure with it indicates the palmar area with which it is associated.

SOLES

Lines A–D. The four main lines; seldom used.
 W. Hallucal pattern of the whorl type.
 A. B. C., AB., BC. Various types of hallucal pattern derived from W by the breaking down of certain of the triradii. (See above.)
 Area 1–3. The three plantar areas.
 1–16. As applied to the main lines, areas, etc., to expressed termini; seldom used. (See diagram, fig. 2, *b*.)
 O. An open area, i. e., one that opens to the inner margin.
 Cl. A closed area.
 + (with 1–3 added). An area confluent with the one indicated by the number.
 L. An upper loop, i. e., one bounding the top of an area.
 \perp_1 – \perp_4 . A lower triradius; the small figure with it indicates the plantar area with which it is associated.

II. — Descriptive Exponents

1. IN CONNECTION WITH THE CARPAL TRIRADIUS (C)
 - x. Large triangle, forming triradius.
 - h. High.
 - l. Low.
 - o. Toward the outer margin.
 - c. Central.
 - p. Like a parting.
 - H. Connected with the hypothenar pattern.
2. IN CONNECTION WITH A PARTING (P).
 - b. Oblique in direction.
 - bt. Oblique, ending in a triradius.
 - btr. Oblique, ending in a rudiment of a triradius.
 - ct. Like a carpal triradius.
3. IN CONNECTION WITH THE PATTERNS (1-3)
 - r. Rudimentary (i. e., vestigial).
 - l. False ; formed by a loop of a main line.
 - t. True ; formed by a lower triradius.
 - u., d., *up* and *down*, referring to the upper and lower loops forming the "thenar" pattern. Morphologically the upper loop is a first interdigital, belonging in the series with the other palmar patterns (1-3), while the lower loop is the true thenar. u, d, and ud indicate the presence of one or the other of the loops, or of both.
4. IN CONNECTION WITH THE HALLUCAL PATTERN
 - a. the outer (= upper) triradius.
 - b. the inner (= marginal) triradius.
 - c. The lower triradius.

[Either of these attached as an exponent to a W signifies that the given triradius is small and almost broken through ; thus almost forming the type represented by the corresponding capital letters.]

 - d. The common form where the lower triradius does not appear through the loss of its divergent, i. e., where the ridges bordering the pattern on its outer side curve around it without showing a triradius.
 - w. Almost a whorl.
 - sp. Core in the form of a spiral.
 - s. Core an S-shaped figure.
 - sm. A long seam, or line of interruption of the ridges, showing the beginning degeneration of a triradius.
5. IN CONNECTION WITH THE PLANTAR AREAS
 - j. An area curves with its lower end around another area.
 - v. The ridges of an area converge below to a point or nearly so.
 - n. Open but very narrow.
 - t. Limited below by a triradius.

II.—STUDIES OF VARIOUS RACES

A. — MAYAS

Material. — For the purpose of testing the ethnological value of the palm and sole markings one could hardly wish for better

material than that furnished by the Mayas of the interior of Yucatan, which, although confessedly no longer a pure race, as they may have been when discovered by the Spaniards, are yet remote enough from other influence to have retained in great part their original characteristics.

For the valuable material upon which I have based my studies of the Maya people I am indebted to Mr Alfred M. Tozzer, of the Peabody Museum at Cambridge, Mass., who, at the cost of much trouble and personal inconvenience, has obtained for me the prints — either full sets or those of the hands alone — of 22 individuals. As may be expected, it is no easy task to obtain prints of primitive races, and since, as stated by Mr Tozzer in a letter written during the work, "each print, especially those of the feet, represents a certain amount of coaxing and arguing to overcome the natural prejudice of a half-civilized people," my debt to him for this valuable material increases in proportion.

TABLE I.—*Lists of Prints used in the Study of the Mayas.*¹

No.	NAME.	SEX.	RELATIONSHIP.	TRIBE.	REMARKS.	PRINTS ²
331	Juan[a] Miz	♀	Sister of 342	Maya	"Undoubtedly a good deal white"	H—
332	Juan Marquez	♂		Mexican		H—
333	Benito Can	♂	Brother of 334 and 335	Maya	} "Fairly pure Indian"	H. F.
334	Luis Can	♂	Brother of 333 and 335	Maya		H. F.
335	Crisostomo Can	♂	Brother of 333 and 334	Maya	} "A little white blood"	H. F.
336	Clotilde Vegara	♀	Niece of 337	Maya		H—
337	Leona Cordero	♀	Mother of 350	Maya	} "A little white blood"	H. F.
338	Felipe Neo	♂		Maya		H. F.
339	Petrona Coroo	♀	Sister of 331	Maya	"Wife of Felipe Neo"	H—
340	Ferenin Tus	♀		Maya	} "As pure Mayas as one finds"	H. F.
341	Nestor Tul	♂		Maya		H. F.
342	Martina Miz	♀		Maya	} "White blood not very far back"	H—
343	Juan Mex	♂		Maya		H—
344	Juan Ruiz	♂		Maya		H—
345	Anita Chan	♀		Maya		H. F.
346	?	♂?	Mother of 349	Maya	} "White blood not very far back"	H. F.
347	Sequeriano Hoyoe	♂		Maya		H. F.
348	Navora Martin	♀		Maya		H. F.
349	Juanita Martin	♀	Daughter of 348	Maya	"Remarkably white for Maya"	H. F.
350	Juan Herrera	♂	Son of 337	Maya	} "A little white blood"	H. F.
351	—	♂		Tabasco		H—
352	—	♂		Tabasco		H—

¹ Collected by Mr Alfred M. Tozzer.

² H = hands ; F = feet

The preceding list of the individuals who furnished the prints, together with the sex, relationship to one another, and comments concerning the race, will show more exactly of what the material consists, and may be useful for later reference.

The remarks are quotations from Mr Tozzer and serve to show "that to find a pure Indian with absolutely no trace of Spanish blood is almost impossible." Whether it is because of this that the prints in so many respects resemble those of the white race, or whether we would find the case similar in an absolutely unmixed people like the Andamanese, is impossible to say. All that can here be done is to present the conditions found in these Maya prints as impartially and exactly as possible, to formulate what conclusions seem to me to be warrantable, and then to leave the matter to the judgment of the reader.

Palms. — The first discussion will be naturally that of the main lines, including the carpal condition, which will map out for us the general outlines, after which may be considered the patterns and other details. Of the 22 sets, two of them, the right hands of Nos. 346 and 351, could not be read; the remainder, consisting of 22 lefts and 20 rights, were extremely satisfactory. Of these the main line formulæ, placed in numerical order, are shown in table II, as follows:

TABLE II.—*Main Line and Carpal Formulæ of 42 Maya Hands.*

No.	FORMULA.	No.	FORMULA.	No	FORMULA.
351 L	7 · 5 · 5 · 1 · C	347 R	9 · 7 · 5 · 3 · C	344 L	10 · 8 ⁷ · 6 · 1 · C
348 L	7 · 5 · 5 · 1 ⁴ · C	350 L	9 ⁴ · 7 · 5 · 3 · P	337 L	10 · 8 · 6 · 5 · C
343 L	7 · 5 · 5 · 1 · C	338 R	9 · 7 · 5 · 5 · C	352 R	10 · 8 ⁹ · 6 · 5 · C
331 L	7 · 5 ⁸ · 5 · 1 · C	335 R	9 · 7 · 5 · 5 · (?)	332 L	10 · 9 · 6 · 3 · C
349 L	7 · 5 · 5 · 2 · C	336 R	9 ¹⁰ · 7 · 5 ⁶ · 5 · P	339 L	10 · 9 · 6 · 3 · P
342 L	7 · 5 · 5 · 3 · C	352 L	9 · 8 · 5 · 1 · C	342 R	10 ⁶ · 9 ⁸ · 6 · 5 · C
335 L	7 · 5 · 5 · 3 · C	340 L	9 ⁴ · 8 · 5 · 1 · C	332 R	10 · 9 · 6 · 5 · C
349 R	7 · 5 · 5 · 5 · C	341 L	9 · 8 · 5 · 5 · C	337 R	10 · 9 · 6 · 5 · C
345 R	7 · 5 · 5 · 5 · C	341 R	9 · 8 · 5 · 5 · C	340 R	11 · 8 ⁹ · 7 · 11 · C
345 L	7 · 5 · 5 · 5 · P	333 L	9 · 9 · 5 · 5 · 2 ¹ · C	344 R	11 · 9 · 7 · 5 · C
347 L	8 · 6 · 5 · 2 · C	346 L	9 ¹⁰ · 9 · 5 ⁶ · 2 · C	333 R	11 · 9 · 7 · 5 · C
336 L	8 · 6 · 5 · 3 · C	334 L	9 ⁴ · 9 · 5 · 3 · C	331 R	11 · 9 · 7 · 5 · C
343 R	8 · 6 · 5 · 5 · C	334 R	9 · 9 · 5 · 5 · 5 ⁴ · C	350 R	11 · 9 · 7 · 5 · P
338 L	9 · 7 · 5 · 3 · C	348 R	9 · 9 · 5 · 5 · C	339 R	11 · 9 · 7 · 5 · (?)

NOTE.—The numerical exponents signify possible alternative interpretation. t signifies a lower triradius in the course of the line. L and R signify left and right.

In the above, 20 separate formulæ are represented, 10 of which occur in left hands alone, 6 in rights alone, and 4 in both. Of the entire number 7 are represented by single hands, 7 more by but 2, and the remaining 6 have 3 or more representatives each. It is of importance to notice that in the first column (14 cases) there are but 3 rights, in the last (also 14) but 4 lefts, while in the middle column the lefts and rights are equally divided. A morphological significance is given to this through the fact that *the formulæ are arranged in accordance with their own numbers, or, in other words, in accordance with the gradual upward movement of the main lines, and that, consequently, in the characteristic human tendency toward a crowding of the ridges upward toward a horizontal position* (Miss Whipple, 1904) *the right hands are considerably in advance of the left.*

This tendency is shown in tabular form as follows :

In 22 lefts, line A takes a position below (5) 19 times or 86%.

In 20 rights, line A takes a position below (5) but once, or 5%.

In 22 lefts, line D takes position (7) 8 times, and position (11) not at all.

In 20 rights line D takes position (7) twice, and position (11) 6 times.

A still more definite proof of this is seen in the relative occurrence in the two hands of the formula 11·9·7·5, which represents the extreme of this tendency. In 20 Maya right hands it is the commonest formula, appearing 5 times, or 25 per cent., while in the lefts it does not occur. This condition might be considered accidental were it not that in 100 right hands of the white race recently investigated, it is also the most common formula, and occurs 22 times (22 per cent.), while in the same number of left hands it is found but 4 times (4 per cent.).¹ The Negro prints (see below) exhibit the same phenomenon. In this same set of whites line A assumes a lower position in 58 lefts and in but 23 rights; line D does not show the tendency as strongly as in the Mayas.

The relative occurrence of the various formulæ of the Maya prints is shown in table III, which may be tested with regard to its ethno-

¹ Table I, p. 402, in "Palm and Sole Impressions," etc., *Pop. Sci. Monthly*, Sept. 1903. This table, together with one deduced from it giving the relative positions assumed by the main lines, will be found in the appendix to this paper.

logical value by comparing it with the table just cited, based on the study of 200 hands of the white race. In these two tables there is a fundamental difference in the relative occurrence of what may be termed the *lower formulæ*, or those in which the first two terms are below 10.8., and the others usually 5 or below. Of these the 42 Maya hands show 28 representatives, or 66 $\frac{2}{3}$ per cent., while of 200 hands of whites there are but 98 representatives, or 49 per cent. This tendency appears to a much greater extent in the Negroes (77 per cent.), and will be considered at length farther on in this paper.

TABLE III.—*Occurrence of Main Line Formulæ in Maya Hands.*

FORMULÆ.	L	R	BOTH.	FORMULÆ.	L	R	BOTH.
7·5·5·1	4	0	4	9·9·5·2	2	0	2
7·5·5·2	1	0	1	9·9·5·3	1	0	1
7·5·5·3	2	0	2	9·9·5·5	0	2	2
7·5·5·5	1	2	3	10·8·6·1	1	0	1
8·6·5·2	1	0	1	10·8·6·5	1	1	2
8·6·5·3	1	0	1	10·9·6·3	2	0	2
8·6·5·5	0	1	1	10·9·6·5	0	3	3
9·7·5·3	2	1	3	11·8·7·11	0	1	1
9·7·5·5	0	3	3	11·9·7·5	0	5	5
9·8·5·1	2	0	2				
9·8·5·5	1	1	2	Totals.	22	20	42

Turning now from the study of the formulæ as a whole to that of the various terminal positions of the separate lines, we may find it convenient to construct such a table as the one given here (table IV), which is readily deduced from table III by counting the number of occurrences of each line in each position and tabulating the results. Thus, to give an example, if we take line C, the second row in the formulæ, we can ascertain the number of times it appears in the position (8) by finding each place in which 8 occurs in the second row, and then ascertaining by the right-hand columns the number of times, in each hand, which the given formula represents. Thus, beginning with the formula 9·8·5·1, the first in which line C occurs as (8), we find two left hands and no rights; in the next formula one left and one right; in the fourth below that, 10·8·6·1, one left and no right, and so on, until, when all are computed, it is found that line C assumes the position represented by (8) in 5 lefts and 3 rights, or 8 times in all. The last column under each of the main lines gives the percentage of the whole which the number of

each occurrence in both hands represents; thus the 8 times of occurrence of line C in position (8) are given as 19 + per cent., in the total of 42 hands.

TABLE IV.—*Frequency of Occurrence of the Various Terminal Positions, with Percentages (Mayas).*

TERMINUS	LINE D				LINE C			
	L	R	Both	% (both)	L	R	Both	% (both)
1	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—
5	—	—	—	—	8	2	10	24—
6	—	—	—	—	2	1	3	7+
7	8	2	10	24—	2	4	6	14+
8	2	1	3	7+	5	3	8	19+
9	8	7	15	36—	5	10	15	36—
10	4	4	8	19+	—	—	—	—
11	—	6	6	14+	—	—	—	—

TERMINUS	LINE B				LINE A			
	L	R	Both	% (both)	L	R	Both	% (both)
1	—	—	—	—	7	—	7	16+
2	—	—	—	—	4	—	4	9+
3	—	—	—	—	8	1	9	21+
4	—	—	—	—	—	—	—	—
5	18	10	28	66+	3	—	21	50
6	4	4	8	18+	—	—	—	—
7	—	6	6	14+	—	—	—	—
8	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—
11	—	—	—	—	—	1	—	2+

This table IV is constructed in the same way as the one published in the article just mentioned, and reproduced as an appendix to this paper representing the positions of the main lines in the hands of 200 whites, and a comparison of the two would show absolutely what differences exist in the relative occurrence of each position in the two races, provided only there were a sufficient number of Mayas to render the percentages perfectly reliable. Something, indeed, may be obtained by a comparison with what I have, as the number 42 is by no means an inconsiderable one, and as proportions should be the subject of comparisons rather than the actual figures in each case, I have prepared table V, in which the percentages of occurrence of the various positions for each main line are

compared for both Mayas and whites. It should be noted, however, that in the tables representing the whites (see Appendix), lines which enter a lower triradius are represented by the symbol alone with no reference to the further course of the line, and as such a nomenclature is insufficient for our present comparison, in order to deduce the percentages given here, I have gone through my collection and replaced this sign wherever it occurs with the definite number representing the terminal position. This will account for a slight disparity in percentages between those given here for the white race, and those stated in the original table.

TABLE V.—*Percentages of the Various Positions of the Main Lines.*

TERMINI.	LINE D.		LINE C.		LINE B.		LINE A.	
	Maya.	White.	Maya	White.	Maya.	White.	Maya.	White.
1	—	—	—	—	—	—	16+	1
2	—	—	—	—	—	—	9+	9.5
3	—	—	—	—	—	.5	21+	20.5
4	—	—	—	—	—	—	—	10
5	—	—	24—	8.5	66+	47	50	58
6	—	—	7+	11.5	19+	13.5	—	—
7	24—	11	14+	33	14+	33.5	—	—
8	7+	12	19+	15	—	5	—	—
9	36—	25.5	36+	26.5	—	.5	—	—
10	19+	13.5	—	5	—	—	—	—
11	14+	38	—	.5	—	—	2+	1

From this final table, which represents the consummation of our labors thus far, as regards the main lines, we may detect what differences there are between the two races, and ascertain the ethnological importance of this comparison; we must remember, however, that the number of Maya prints that serve as a basis for the percentages here given is too small a one to be wholly reliable, and that the heterogeneous set of individuals referred to as the "white race" contain an admixture of very many original strains, hopelessly intermingled since prehistoric times, which can consequently hardly be expected to show any definite racial characteristics. The only fair comparison would be that between 100 individuals each of two relatively pure races, as the Andamanese and the Hudson Bay Eskimo for example, in which the differences may be expected to be more pronounced. As deduced from the above table the Maya main line characteristics, as compared with the somewhat vague standard of the "white race," are as follows:

- (a) *A low, or very low, position of line A.* Sixteen per cent. terminate within the carpal triradius, and 9 per cent. enter this point, making a total of 25 per cent. which open below the free margin, as compared with 10.5 per cent. in the whites. Exactly 50 per cent. of the termini are too low to be counted as (5) as compared with 31 per cent. in the whites. As a hypothenar pattern almost never occurs in the Mayas, position (4) seems to be unknown.
- (b) *Line B seldom terminates above (6) and opens on the outer margin in exactly two-thirds of the cases examined.* In the whites 39 per cent. of B termini are above (6); in Mayas 14 per cent.
- (c) *Line C opens on the outer margin three times as often as in whites (24 per cent. vs. 8.5 per cent.), but is most frequently either obsolete (8) or curved abruptly inward (9) forming a narrow loop.* Fifty-five per cent. of the cases show one of these two relations, as opposed to 41.5 per cent. in the white race. In the latter 5.5 per cent. of the cases pass beyond (9); in Mayas there are no instances of it.
- (d) *The most frequent position for line D is (9), (36 per cent. as opposed to 25.5 per cent. in the whites), and as it is almost universal in those individuals characterized as being the purest Mayas, it may safely be taken as the most typical Maya position.* Next in order is position (7), in which, with its 24 per cent. of instances, it considerably surpasses the 11 per cent. of the white race. A union with line B (10) is also more common than in the whites (19 per cent. vs. 13.5 per cent.).

The results of the study of the carpal region are given in table VI, in which a comparison is also shown by giving at the left similar results deduced from the hands of 100 persons of the white race. This area is usually characterized by the presence of a carpal triradius, which, although in most cases morphologically the lower inner triradius belonging to the hypothenar pattern (Miss Whipple, 1904), is nevertheless independent of this latter in its occurrence, and often appears where there is no such pattern or where the pattern is so far removed from it that its connection is not realized. This is the condition expressed by the first six designations of the table, where the descriptive suffixes refer merely to size and relative position of the triradius; occasionally, however, this triradius is plainly a part of the hypothenar pattern, a relation indicated by the last

two designations C^H and C^{hH} , the latter introducing an additional exponent to signify position. C^p , the seventh designation, signifies a somewhat incomplete triradius that might almost be considered a parting.

TABLE VI.—*Comparison of Carpal Characters in Whites and Mayas.*

WHITES, 200 HANDS.					MAYAS, 40 HANDS.				
Character	Left	Right	Both	%	Character	Left	Right	Both	%
C	31	27	58	29	C	6	4	10	25
C^x	3	3	6	3	C^h	3	2	5	12.5
C^h	6	9	15	7.5	C^L	8	7	15	37.5
C^L	7	5	12	6	C^o	2	3	5	12.5
C^o	2	4	6	3					
C^c	7	8	15	7.5					
C^p	1	3	4	2					
C^H	6	8	14	7					
C^{hH}	6	1	7	3.5					
Total C	69	68	137	68.5		19	16	35	87.5
P	23	24	47	23.5	P	2	2	4	10
P^b	1	1	2	1					
P^{bt}	5	2	7	3.5	P^c	1	—	1	2.5
P^{btr}	2	3	5	2.5					
P^c	—	2	2	1	Total P	3	2	5	12.5
Total P	31	32	63	31.5					
Area	36	39	75	37.5	Area	9	7	16	40

Abbreviations: C = carpal triradius, P = parting, Area = that below the carpal triradius, enclosed by its lower divergents. The exponents are "descriptive suffixes" and are to be interpreted as follows: x = large; h = high; l = low; o = toward the outer margin; c = central; p = like a parting; H = forming a triradius of a hypothenar pattern; b = oblique; bt = oblique, ending in a triradius of the hypothenar pattern; btr = oblique, ending in a rudiment of a triradius; c = like a carpal triradius.

The typical parting, P, is the less frequent case in which the ridges of the wrist merely divide at the middle and pass in two directions, often leaving a small area in the form of a very narrow V. That such a condition is morphologically that of a carpal triradius deficient below and lacking the transverse ridges which are necessary to complete the third side of the triangle, is shown by the existence of such transition forms as C^p or P^c , between which the distinction is often arbitrary. A parting frequently extends in an oblique direction upward and outward to the hypothenar center (P^b) where it may become directly continuous with a triradius, which is mor-

phologically the carpal triradius in a somewhat unusual position. This condition I have designated as P^{bt}, but this passes by almost imperceptible gradations into a simple C. Where the triradius is rudimentary the designation becomes P^{btr}.

Since the carpal triradius is morphologically a part of the great hypothenar pattern which occurs but twice in 44 Maya hands, it might naturally be supposed that the former character would also be infrequent; *the reverse, however, seems to be the truth, and a carpal triradius occurs in the Mayas in 87.5 per cent. of the cases as against 68.5 per cent. in the whites; similarly the occurrence of a parting is in the Mayas but 12.5 per cent., and in the white race 31.5 per cent.* The commonest type of carpal triradius in the Maya hand is a very low one, too near the margin to leave room for a carpal area, a type that occurs in 37.5 per cent. of all the hands examined, as opposed to but 6 per cent. in the case of the whites. When a parting occurs in a Maya hand it is of the simplest type, and appears correlated with the existence of white blood. (Compare table II with table I.)

TABLE VII.—Occurrence of Patterns in Palm. (Mayas and Whites.)

DESIGNATION OF PATTERN.	MAYA (44)				WHITE (100)			
	L	R	Both.	%	L	R	Both.	%
Hypothenar.	1	1	2	4.5	20	21	41	41
Thenar (up and down).	12	10	22	50.0	4	3	7	7
1 (Triradius).	0	2	2	4.5	1	1	2	2
2 (Triradius).	0	0	0	0	1	0	1	1
2 (Loop).	5	10	15	34	15	22	37	37
3 (Triradius).	8	5	13	29.5	8	7	15	15
3 (Loop).	7	6	13	29.5	25	19	44	44
Total.	33	34	67	152 ¹	74	73	147	147

The occurrence and comparison of palmar patterns in the hands of Mayas and whites (44 of the former and 100 of the latter) are shown in table VII, in which will be noticed at once the most positive result yet obtained, namely, *that the thenar pattern is characteristic of the Maya hand and the hypothenar of the white.* Fifty per cent. of the Maya hands possess a thenar pattern and but 7 per cent. of the whites, while in the case of the hypothenar the figures are

¹ See note, table XVI.

almost reversed : 4.5 per cent. to 41 per cent. The difference is a little more noticeable if we consider individuals, not hands ; since, of the 22 Mayas whose hands appear in the table, 13 were characterized by a thenar and but one by a hypothenar, and of the 50 whites of the same table 24 possess a hypothenar and but four a thenar.

It is important to note that the term "thenar" as used here is employed in its topographical and not in its morphological sense, and implies any pattern or definite pattern rudiment occurring upon the anatomical thenar region. A typical thenar pattern, used in this sense, is in reality a double one, and its most usual form consists

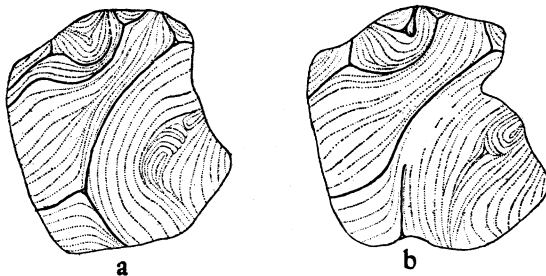
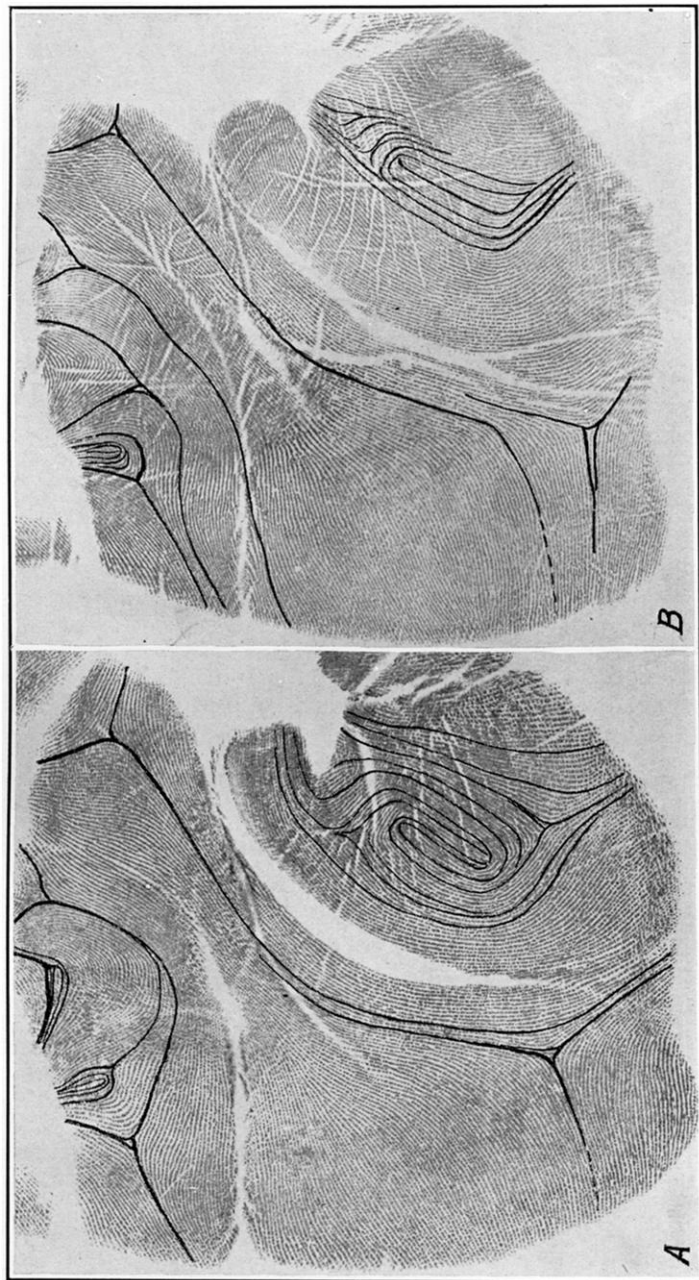


FIG. 4. — Types of Maya palm prints. Two-fifths natural size. Compare with plate x. (a, Cat. No. 352. b, Cat. No. 339.)

of two loops placed end to end, that is, with the sharpest part of the curve of each in contact and directed in opposite ways. (See the Tabasco hand, fig. 4, *a*.) Of these two loops, distinguished in formulæ as *u* and *d* (*up* and *down*), only the lower one (*d*) is in reality a thenar, the upper one (*u*) being the first of the series of interdigitals occurring typically between the various digits, and corresponding to the interval between the thumb and index. Each of these loops, the true thenar and the first interdigital, represents a primitive mammalian pad, and they are brought into this close proximity in the lower Primates as a result of the opposition of the thumb. In a topographical "thenar" pattern, either of these two loops may be alone represented (fig. 4, *b*), or both may occur side by side ; or, again, one may be well developed and the other more or less rudimentary, consisting perhaps of a few oblique lines without a loop (plate x). Thus in the 22 instances among the Mayas, four (two rights and two lefts) exhibit the upper loop alone, six



PALM PRINTS OF MAYAS, SHOWING THENAR PATTERNS (NATURAL SIZE)
A, Catalogue No. 344; formula: $10 \cdot 87 \cdot 6 \cdot 1 \cdot C^{ob}$. *B*, Catalogue No. 342; formula: $7 \cdot 5 \cdot 5 \cdot 3 \cdot C^o$.

(three rights and three lefts) the lower one alone, and the remaining 12 both loops, at least as rudiments, seven in left hands, and five in rights. Of the seven thenars that appear in the 100 white hands, one is represented by the upper loop, three by the lower, and the remaining three by both, the patterns, when they occur, being as typical and well-developed as in any Maya. In the other patterns, the 1st-3d palmar being those of the 2d, 3d, and 4th interdigital pads, respectively, a distinction is made in the table between true and false patterns, the former, which are the only patterns in the morphological sense, being those in which a definite triradius occurs, other than the digital one. False, or loop, patterns are defined by the recurving of a main line, most commonly line C, and seem to be merely the result of the general upward tendency of the ridges in the (human) attempt to place them in the horizontal position, i. e., straight across the palm. A comparison of these patterns does not reveal any marked difference in the two races, the 2 (loop), for example, showing relatively 34 and 37 per cent. In pattern 3 the Mayas are more apt to show a true one (with a triradius), but if both types of pattern be added in each race, the result is 59 per cent. in both Mayas and whites. In fact, the total occurrence of patterns is remarkably constant in the two races, being, in comparison with the number of hands studied, 152 per cent. in the Mayas and 147 per cent. in the white race; and a similar constancy of occurrence is noted in each race in the rights and lefts. In this connection it is noteworthy that the percentages of thenar and hypothenar are nearly reversed in the two races, thus retaining the average occurrence of patterns.

Summary of Maya Palm Characteristics.

- (a) *Main lines*: A large percentage of occurrence of the "Lower formulæ," in which the position of line A is apt to be especially low (3), (2), or (1), showing that there is a pronounced downward slant to the ridges crossing the palm. Line B opens to the outer margin twice as often and line C three times as often as in the white race, although for the latter line the most frequent position is (9). This same position (9) is also the most characteristic one for line D, and seems to occur in proportion to the purity of the Maya blood.

- (b) *Carpal area* : A carpal triradius is almost universal, the characteristic type being a very low one at the margin of the print, and with almost no carpal area ; a parting is rarely found, and seems in every instance to indicate white blood.
- (c) *Patterns* : A great frequency of the thenar pattern, and a corresponding rarity of the hypothenar, the percentage of occurrence of the two being about the reverse of that in the whites ; a third lower triradius, and consequently a true pattern 3, is much more frequent than in the whites, but the sum total of both triradius and loop patterns is the same in the two races.

Soles.—As shown above, the configuration of the human sole does not lend itself as readily to expression by means of brief descriptive formulæ as does the palm, and this for two main reasons ; first, that the friction skin, bearing with it certain elements essential to the complete interpretation of the configuration, extends up on the sides of the foot considerably beyond the region of contact, or that of an ordinary print, and, secondly, that the conditions are often much more complicated than in the palm. Thus certain of the digital triradii are apt to be situated in the hollow under the toes, where no satisfactory print can be obtained, both because of the abrupt curve of the surface as well as from the fact that the ridges in this sheltered locality are soft and poorly developed. The great complexity of many soles is due (1) to lower triradii, which are not only far more frequent than in the palm, but possess a more extensive influence, entering into various relations with the main lines and other features ; (2) to the tendency of the digital lines to become recurved and to run over the sole ; (3) to the fact that the interdigital areas are, for the greater part, in contact with one another, without the intervention of intermediate areas ; and (4) because the patterns themselves are apt to be more complex.

In attempting, then, the study and comparison of the soles of various human races, I find it impracticable to use main line formulæ or to conform in other respects to the method found serviceable in the case of the palm, but prefer to substitute for them features which seem the most available for comparison, the hallucal patterns and the interrelations of the various areas, points that appear clearly marked upon all ordinary prints, and which are in themselves easily described and formulated.

If, after becoming well accustomed to the sole configuration in members of our own race, one turns, as I have done, to a set of Maya sole-prints, they will produce at once an impression both of excessive similarity to one another and of a general unlikeness to those with which he is familiar. This is seen in the four outlines presented in fig. 5, which represent nearly the widest range of

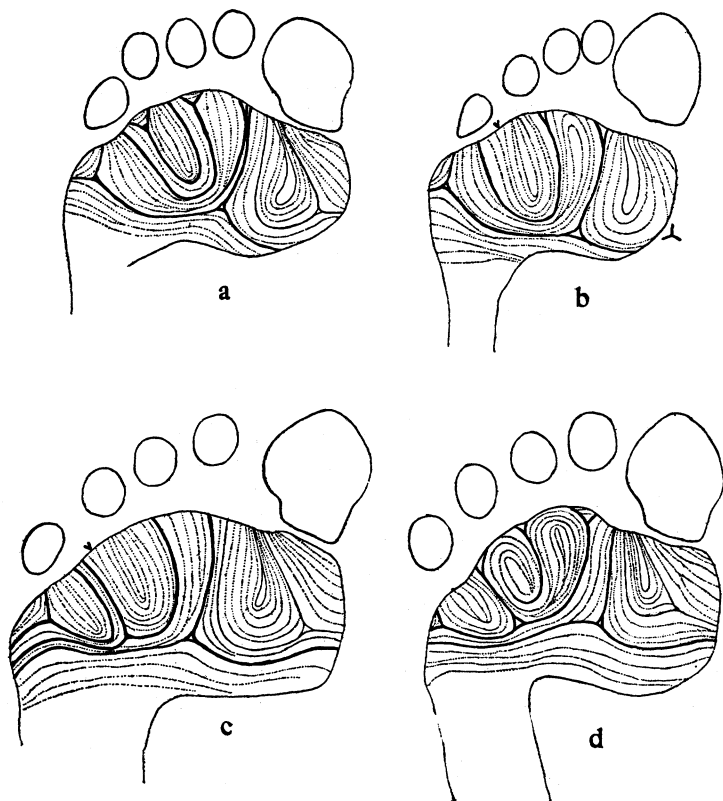


FIG. 5. — Types of Maya sole prints. Two-fifths natural size. Compare with plate xi. (a, Cat. No. 337. b, Cat. No. 348. c, Cat. No. 335. d, Cat. No. 340, right reversed.)

variation found in my collection of 26 (13 individuals; see table 1). That these prints are similar to one another in some general way strikes one at once, but it may take some little time and a further chance for comparison before it is noticed that this similarity is due in great part to the almost constant presence of a large lower triradius,

placed below the interval between the great toe and the rest, and possessing two extensive lower radiants which stretch almost horizontally across the sole and entirely exclude from the inner margin the lines and ridges of the three plantar areas. The radiants of this triradius are fairly constant in direction and relation, and are as follows in the various individual cases :

Upper¹ radiant :

Within line A.	15	instances
Fusing with line A.....	3	"
Without line A.....	3	"

Inner radiant :

Below inner hallual triradius.....	18	"
Fusing with inner hallual triradius.....	2	"
Above inner hallual triradius.....	1	"

Outer radiant :

Below line D.....	11	"
Fusing with line D.....	4	"
Above line D.....	6	"

From these statistics the characteristic position and relationships of this lower triradius are ascertained: *the upper radiant passes within line A, thus bringing the entire triradius into close relationship with the hallual pattern*; the inner and outer radiants form together a nearly horizontal line, extending below both the hallual pattern on the inside and the origin of line D on the outside, and thus *excluding from the inner margin all the ridges that form a part of any of the plantar areas*. In this effect the four cases in which the outer radiant fuses with line D should be added to the other eleven, making 15 instances in which none of the upper ridges escapes this barrier. In the six cases in which the outer radiant lies above line D, it runs through the middle of the 3d plantar area, and only those few ridges, 8-10 in number, which lie between it and line D, are allowed to escape.

It will be seen from the above that only 21 lower triradii are accounted for out of 26 soles, and this is because five do not

¹ The designations *upper*, *inner*, and *lower*, as used here, are merely topographical, and are the best suited to descriptive use; the true morphological relations cannot in all cases be determined.

possess the character. In four of these, however, the triradius is rudimentary, that is, its position is marked by a convergence of ridges, and in one of these cases they are disposed in such a way as to shut off the inner margin as though a definite triradius were present. *It is a tempting hypothesis to account for such cases as due to the influence of white blood, since an open access to the inner margin and the absence of a retaining triradius form a type especially abundant in the white race, and this may indeed be the truth, owing to the actual admixture of white blood in the present-day Mayas. It seems impossible, however, to find any character in the exclusive possession of a given race, and even this condition, which may almost be termed the "Maya type," occasionally occurs in every detail in a white. To make a more definite comparison of this point, I selected at random from my collection the sole-prints of 13 individuals of the white race, the results from which, as compared with the Mayas, are as follows :*

	<i>Mayas</i> (26 soles)	<i>Whites</i> (26 soles)
"Maya type," i. e., a large lower triradius, excluding the plantar areas from the inner margin.....	21 (81%)	5 (19%)
"White type," i. e., no large lower triradius, the plantar areas opening freely to the inner margin....	8 (30%)	18 (70%)

The recent investigations of Miss Whipple show that there are in the human sole typically four lower triradii, one belonging to the hallucal pattern and one to each of the three plantar patterns ; and that, furthermore, they are brought so near together by the convergence of the four areas in question that in some cases, especially in that of the 1st and 2d (hallucal and 1st plantar) it is impossible to decide to which one a given triradius belongs. A large lower triradius occurring in the white race in approximately the same place as in the Mayas is perhaps best accounted for as a fusion of the two, especially as it occasionally appears partly double ; but *in one important respect the triradius in question differs in the Mayas from its condition as found in the whites, and that is, in the*

almost constant position of its upper radiant inside of line A, and in its consequent close relationship to the hallucal patterns (with certainty in 19 out of 26), thus suggesting that as a rule it is, in the Mayas, not a fusion of \perp_1 and \perp_2 but the former alone ; while it seems in the whites more often to represent either \perp_2 , that is, the lower triradius of the 1st plantar pattern, or a fusion of this with that of the hallucal pattern.

The two remaining lower triradii (\perp_3 and \perp_4) are more definite in position and usually easy to distinguish. The first of these, that of the 2d plantar pattern, appears just below the corresponding area and is usually so arranged that its upper and outer radiants together form a broad loop, enclosing the 2d plantar pattern, while the remaining radiant, the inner one, rises from the center of the aforesaid loop and runs obliquely to the inner margin. This triradius in the above, or typical form, is fairly frequent in the white race, occurring four times in the 26 feet used for comparison, but is not once indicated in the same number of Mayas. The fourth lower triradius, on the other hand, seems to be frequent in the Mayas and rare in the white race. This is the one shown in fig. 5, *d*, and appears, always in connection with more or less definite patterns, between the 2d and 3d plantar areas. In the 26 Mayas 8 instances of this are seen, or about 30 per cent., but in the 26 whites it occurs but once as a complete triradius and is indicated once by a convergence of ridges.

Summing up the results obtained covering the lower triradii of the Mayas, although the material employed is far too scanty for definite results, we have the following :

- (a) A large triradius, approximately beneath the interspace between the hallux and the second toe, is almost universal among the Mayas ; its two lower radiants extend horizontally across the foot in such a way as to exclude the three plantar areas from the inner margin ; its upper radiant is more usually within than without line A, suggesting that its morphological significance is that of the hallucal lower triradius, or \perp_1 . A similar triradius is infrequent among the whites and, when present, appears through its general relationship to be either a fusion of \perp_1 and \perp_2 or the latter alone.
- (b) The lower triradius of the 2d plantar area (\perp_3), not infrequent in the white race, does not appear with certainty in the Mayas.

- (c) The lower triradius of the 3d plantar area (\perp_4) is common in the Maya race, but infrequent among the whites.

For the study of plantar areas I have prepared three tables, the first of which, table VIII, gives the formulation of the 26 Maya soles, the second, table IX, a similar formulation of four like sets of whites, 26 each; and in the third, table X, there are given the actual occurrence and the percentage of each type of pattern both in the sole as a whole and in the separate plantar areas in whites and Mayas. By means of table IX the important point is established that *the number 26 is sufficient to give the characters of a race with approximate correctness, since the figures of the four sets, A-D,*

TABLE VIII.—Sole Formulae of 13 Mayas.

No.	LEFT SOLE.	RIGHT SOLE.
333	A . O . 5 . Cl	A . 5 . Cl ^v . Cl
334	A . 5 . Cl . Cl	A . 5 . Cl . Cl
335	A . Cl . Cl . Cl	A . 5 . Cl . Cl
337	A . +3 . Cl +3 . +I +2	A . +3L . Cl . +IO
338	W . +3 . Cl . +IO	AB . +2 + 3 . Cl . +IO
341	A . +3 . Cl . +IO	W . O . Cl ^v . O
340	A . +3L . ClL . +I	A . +2L . +ICIL . Cl
345	A . O . O . O H	A . 5 . 5 ^v . Cl . H
346	A . Cl ^v . O . O	B . ClOL . O . O
347	A . 5 . Cl . Cl	A . 5 . Cl . Cl
348	A . +3L . Cl . +I	A . +3L . Cl . +IO
349	A . Cl ^v . Cl +I . O	A . +3 . Cl . +IO
350	A . +3 . Cl . +I	W . +35 . Cl . +I

NOTE.—The W patterns are all typical whorls, with cores formed of concentric circles, and with three triradii.

are in the main not very different from one another or from the general average, a principle the establishment of which allows us to draw conclusions from the small number of Maya prints with some little confidence. It must be acknowledged, however, that while in the 52 whites represented there are no cases of blood relationship so far as I can ascertain, several of the Mayas are thus related, as given in table I, and that, consequently, certain of the characters considered racial may be merely those of a family. Thus in the oft recurring formula of table VIII, A·5·Cl·Cl, four out of the six cases belong to the brothers "Can," Nos. 333–335, and thus invalidate the conclusion that the formula in question is a racial character.

TABLE X.—*Showing Proportionate Occurrence of Special Sole Characters in the Four White Series, A—D, and in the Mayas.*

CHARACTERS	ACTUAL FIGURES					PERCENTAGES					Plantar area characters; occurrence on each area. Percentages on basis of 26.	
	A	B	C	D	Av. ¹	Maya	A	B	C	D		Av. ¹
Open areas [O]	46	49	48	53	49	18	59	62.8	61.5	67.9	62.8	23
Closed areas [Cl]	28	29	25	17	24½	35	35.9	37	32	21.7	31.7	44.8
Confluent areas [+]	7	8	9	16	10	27	9	10.3	11.5	20.5	12.8	34.6
Areas with upper loops [L]	11	13	7	3	8½	8	14	16.6	9	3.8	10.9	10.2
Areas opening outward [5]	1	0	2	1	1	10	1.3	0	2.6	1.3	1.3	12.8
Hallucal pattern A	10	13	16	12	12¾	21	38.4	50	61.5	46.1	49	80.8
Hallucal pattern other than A	16	13	10	14	13¼	5	61.5	50	38.4	53.8	51	19.2
{	Area 1	13	15	16	18	15½	4	50	57.6	61.5	70	15.4
	" 2	12	10	11	14	11¾	3	46.1	42.2	53.8	45.1	11.5
	" 3	21	24	21	21	21¾	11	80.7	92.2	80.7	83.6	42.2
{	Area 1	8	8	9	2	6¾	4	30.8	34.6	7.7	26	15.4
	" 2	15	17	12	14	14½	21	57.6	65.4	46.1	53.8	80.7
	" 3	5	4	4	1	3½	10	19.2	15.4	3.8	13.5	38.4
{	Area 1	4	4	3	8	4¾	13	15.4	11.5	30.8	18.3	50
	" 2	0	3	3	3	2¾	3	0	11.5	11.5	8.6	11.5
	" 3	3	1	3	5	3	11	11.5	11.5	19.2	11.5	42.2
{	Area 1	7	8	5	1	5¼	6	26.9	30.8	3.8	20.2	23
	" 2	2	5	2	1	2½	2	7.7	19.2	3.8	9.6	7.7
	" 3	0	0	0	1	¾	0	7.7	0	3.8	1.9	0
{	Area 1	1	0	0	1	1½	8	3.8	0	3.8	1.9	30.8
	" 2	0	0	2	0	½	2	0	0	3.8	1.9	7.7
	" 3	0	0	0	0	0	0	0	7.7	0	0	0

Plantar area characters; occurrence irrespective of area. Percentages on basis of total possible occurrence, i. e., $26 \times 3 = 78$. Hallucal patterns. Percentages on basis of 26, i. e., one for each sole.

Plantar area characters; occurrence on each area. Percentages on basis of 26.

¹ The averages are those of the four white series, A—D, for comparison with the Mayas.

In comparing the Maya formulæ with those of the whites, tables VIII and IX, the most apparent difference is *the large number of open areas in the former and of the closed areas in the latter*, differences which are well shown in table X, where the average of the four white sets may be compared with the single Maya set. Out of the 78 possible patterns in each case (26×3), 49 of them, or 62.8 per cent., are open in the whites, and but 18, or 23 per cent. in the Mayas; while if the closed patterns be similarly compared, there are on an average not quite 25 out of 78 in the whites, as contrasted with 35 in the Mayas, or 31.7 per cent. to 44.8 per cent.

The next comparison, that of the occurrence of confluent, or partly confluent, areas, shows *nearly three times as many cases in the Mayas as in the whites*, or 13 per cent. against 34.6 per cent. Areas exhibiting the phenomenon of upper loops are of practically equal occurrence in each race, 10.9 per cent. vs. 10.2 per cent., but *in the computation of areas which open outward, the Mayas show 12.8 per cent. against 1.3 per cent. in the whites; that is, a fair proportion of occurrence against one that is a great rarity*. This is plainly correlated with the almost constant occurrence in the Mayas of a large lower triradius, stretching with its radiants across the sole and cutting off the inner margin, thereby directing the ridges of the first two areas, and of area 1 especially, toward area 3 and the outer margin. Nearly all of these instances are those of area 1, which fails wholly or in part to rise high enough to come within line D and the 4th digital triradius.

Comparing the separate plantar areas by themselves we note the following (table X, lower half, two right-hand columns):

Area 3 is in both races more apt to be open than are the others, and area 2 is more frequently closed. An open area 3 occurs in 83.6 per cent. of the whites, and a closed area 2 in 80.7 per cent. of the Mayas. The most common fusions are those between areas 1 and 3, 2 being seldom involved. An area with an upper loop is rare, except in area 1, where it is fairly common in both races (20-23 per cent.). The opening outward of an area (position 5) seems never to be possible for area 3, and in the white race is rare for the other two areas; in the Mayas it occurs occasionally in the case of area 2, and in area 1 is so common (30 per cent.), in correlation with the large lower triradius, that it may be considered a race character.

The hallucal pattern is overwhelmingly of one type, A, the one the core of which opens upward to the interval between hallux and digit II (80.8 per cent.). Nowhere near so great a proportionate occurrence of this type occurs among any of the other races examined, and in the whites, where it seems to be quite characteristic, the actual occurrence is but 49 per cent. In the Mayas the outer triradius, i. e., the one between it and area 1, is usually preserved, but is generally absent in the whites. Practically the only other pattern that occurs is the whorl, which appears in its most primitive form, with three triradii and with a core of concentric circles.

Summary of Maya Sole Characteristics.

- (a) *Plantar areas (as a whole)* : Usually excluded from the inner margin by means of the radiants of a large lower triradius between hallucal and first plantar area. In correlation with this, areas 1 and 3 become confluent in a broad sweeping curve, enclosing area 2.
- (b) *Plantar areas (separately)* : Area 1 confluent with area 3, either completely or with some of the ridges of area 1 separated by line D, and thus forced to open at the outer margin. Area 2 a broad loop surrounded by the U-shaped ridges of the confluent areas 1 and 3, thus making it a closed area. Area 3 either confluent with area 1 or with a lower triradius which embraces a part of its ridges, making it partially closed.
- (c) *Hallucal pattern* : Usually the A type, with outer triradius (i. e., the one between it and plantar area 1) persistent (19 out of 26). Aside from this there sometimes occurs the primitive whorl (W) with a core of concentric circles and with all three triradii present.
- (d) *Hypothenar and Calcar patterns* : The hypothenar seems to occur but rarely. The calcar has not been observed.
- (e) *Maya formula* :¹ As composed from the most frequent symbol for each position, the characteristic Maya sole formula would be the following :

$$A \cdot + 3 \cdot Cl \cdot + 1$$

¹ The attempt to establish a racial formula by uniting the most characteristic symbols for each part designated seems in general hardly warrantable, since the resulting combination seldom if ever occurs. Thus I have given up the attempt in most cases, e. g., Maya palms. Here, however, the similarities are so great and certain characters so constant in their occurrence that I let it stand as an experiment.

Other common or, at least, characteristic conditions are for area 1 (5); and for area 3 the escape of a part of its lower ridges by the inner margin (+ 1, O), also its closure by means of a third lower triradius (Cl.). This would give, as other common formulæ, closely related to the above,

$$A \cdot 5 \cdot Cl \cdot + 1O$$

$$A \cdot 5 \cdot Cl \cdot Cl$$

Although in 26 Maya soles the first of these occurs 8 times, and the third 6 times, 14 in all, or, if we include two with a W hallucal pattern, 16, i. e., 71 + per cent., in 104 white soles they occur but 5 times, or, with the same latitude as to hallucal patterns, 9 times (7 per cent.). As to characteristic white formulæ, the commonest is the simple $A \cdot O \cdot O \cdot O \cdot$, which occurs, with latitude as regards type of hallucal pattern and with a few other slight modifications, 39 times in the 104 soles, or 37.5 per cent. Still cases occur in both races which might well belong to the other; thus, No. 60 of series A, table IX, might well be a Maya, save for the spiral core to the hallucal pattern, and Nos. 345 and 346 of table VIII might be white. As a matter of fact there is white blood in No. 345, and perhaps in 346, but who shall say that the Maya-like formulæ of certain whites denote aboriginal ancestry? Even this is, of course, possible, but in view of the occasional similarity in individual cases in all the races thus far examined, such a conclusion is neither likely nor necessary.¹

B. — AMERICAN NEGROES

Material. — My Negro material is a little more extensive than is that from the Mayas, and is wholly due to the kindness of my assistant, Miss Whipple, who personally collected the entire set, in great part from two institutions in Providence, R. I., the Shelter for Colored Children, and the Home for Aged Colored Women. Miss Whipple received much kindness and assistance from the matrons

¹ In this connection it may be interesting to note that in both soles of the woman mummy of the "Basket-people," the restoration of which has been recently described by me (*Amer. Anthropologist*, 1904, vol. VI, pp. 1-17), the formula was the simple $A \cdot O \cdot O \cdot O \cdot$, in one case with a well-formed hypothenar loop. The right hand, also, showed an extensive hypothenar pattern of the loop type. The main line formula was 11.8.7.5.C., also more like the whites than the Mayas.

and other officials of those institutions, help that has contributed in no small degree to the completion of this paper.

The following table will show the material employed and the relationship and purity of race of the individuals involved :

TABLE XI.—*List of Prints used in the Study of the American Negroes.*¹

CAT. NO.	SEX.	NAME OR DESIGNATION.	RELATIONSHIP, RACE, ETC.
124	♀	Mrs Thomas	
125	♀	Bessie	Daughter of 124
126	♀	A. C. W. No. 1	Inmate, A. C. W.
128	♀	A. C. W. No. 3	$\frac{1}{4}$ to $\frac{1}{2}$ Negro, inmate, A. C. W.
129	♀	A. C. W. No. 4	Matron, Home for A. C. W.
130	♀	A. C. W. No. 5	Aunt of 129, inmate, A. C. W.
166	♀	Viola Jackson	Sister of 167 and 168
167	♂	Arthur Jackson	Brother of 166 and 168
168	♂	George Jackson	Brother of 166 and 167
169	♂	Oswald	Brother of 170
170	♀	Louise	Sister of 169
171	♂	Andrew	Brother of 172
172	♀	Hope	Sister of 171
173	♀	Alice	Sister of 174
174	♀	Mary	Sister of 173
175	♀	Ethel	Sister of 176
176	♀	Lulu	Sister of 175, light color
177	♀	Leola	Very black
178	♂	John	
179	♂	Joseph	
180	♂	Eddie	"Possibly some white blood"
181	♂	Martin	Father Irish, mother nearly white
182	♂	Clarence	Very black
365	♀	Maggie Logan	Nurse maid

Palms. — The study of the palm prints of the above 24 individuals yielded the results expressed in table XII, in which are given the main line, the carpal, and the pattern formulæ.

Of main-line formulæ, which are arranged in numerical order in table XIII, there are 24 varieties, although the first, 6·5·5·3', is practically a 7·5·5·3', in which the loop is reduced in zero, thus rendering line D entirely obsolete ; and in the single instance of 7·9·5·11', the fourth term is almost a 5 with an intervening triradius.

From this table it will readily be seen that *the lower formulæ, or those in which the first two terms are below 10.6, are more marked than in the Maya race. Thus in the whites 98 out of 200 formulæ, i. e., 49 per cent., were below this point ; the Maya showed 28 out of 42,*

¹ Collected by Miss Inez Whipple. All are complete sets (palms and soles) except No. 125, with palms alone.

TABLE XII.—*Main Line, Carpal, and Pattern Formulæ of 48 Negro Hands.*

CAT. NO.	MAIN LINE AND CARPAL FORMULÆ—LEFT.	MAIN LINE AND CARPAL FORMULÆ—RIGHT.	PATTERN FORMULÆ—LEFT.	PATTERN FORMULÆ—RIGHT.
124	7 · 5 · 5 · 3 · C ^o	7 · 5 · 5 · 3 · C ^o	o · o · o · o · 3 ^l	o · o · o · o · 3 ^l
125	7 · 5 · 5 · 5 · P	7 · 5 · 5 · 5 · C ^c	o · θ · o · o · 3 ^l	H · o · o · o · 3 ^l
126	7 · 5 · 5 · 3 · C ^c	8 · 6 · 5 · 5 · C ^c	o · o · o · o · 3 ^l	o · o · o · o · 3 ^l
128	11 · 10 · 8 · 5 · C ^c	9 · 9 · 5 · 5 · C ^c	o · o · o · 2 ^l · o	o · o · o · 2 ^l · o
129	6 · 5 · 5 · 3 · C ^o	8 · 6 · 5 · 5 · C ^o	o · o · o · o · o	o · o · o · o · 3 ^l
130	7 · 5 · 5 · 5 · C ^{ho}	7 · 5 · 5 · 5 · C ^{ho}	o · o · o · o · 3 ^l	o · o · o · o · 3 ^l
166	7 · 7 · 5 · 5 · C ^h	11 · 9 · 7 · 5 · C ^h	o · θ · o · 2 ^l · 3 ^t	o · θ · r · o · 2 ^l · 3 ^t
167	9 · 7 · 5 · 5 · C ^o	9 · 7 · 5 · 5 · C ^o	o · o · o · o · 3 ^l	o · o · o · o · 3 ^l
168	10 ^t · 9 · 6 · 5 · C ^c	7 · 9 · 7 · 5 · C ^c	H · r · o · o · 2 ^l · 3 ^t	o · o · o · 2 ^l · 3 ^t
169	9 · 9 · 5 · 5 · C ^h	11 · 9 · 7 · 5 ^t · C ^o	o · o · o · 2 ^l · 3 ^u	o · o · 1 ^{tr} · 2 ^l · o
170	9 · 7 · 5 · 5 · C ^c	9 · 7 · 5 · 3 · C ^o	H · o · o · o · 3 ^l	H · o · o · o · o
171	9 · 8 · 5 · 5 · C ^o	9 · 7 · 5 · 5 · C ^o	o · o · o · o · o	o · o · o · o · 3 ^l
172	9 · 7 · 5 · 1 · C ^o	9 · 7 · 5 · 2 ³ · C ^o	o · o · o · o · 3 ^l	o · o · o · o · 3 ^l
173	7 · 9 · 5 · 5 · C ^h	11 ^t · 9 · 7 · 5 ^t · C ^{ho}	o · θ · o · 2 ^l · 3 ^t	o · θ · o · 2 ^l · 3 ^t
174	7 · 8 · 5 · 3 · P	11 ^t · 9 · 7 · 5 · C ^c	o · θ · o · o · 3 ^t	o · θ · o · 2 ^l · 3 ^t
175	7 · 7 · 5 · 5 · C ^c	7 · 9 · 7 · 5 · C ^c	o · o · o · o · 3 ^t	o · o · o · 2 ^l · 3 ^t
176	7 · 5 · 5 · 5 · P	8 · 6 · 5 · 5 · P	o · o · o · o · 3 ^l 3 ^t	H · o · o · o · 3 ^l
177	11 · 9 · 7 · 5 · P	9 · 7 · 5 · 5 · C ^c	H · o · o · 2 ^l · 3 ^t	o · o · o · o · 3 ^l
178	7 · 5 · 5 · 2 · P	8 · 6 · 5 · 3 · C ^c	o · o · o · o · 3 ^t	o · o · o · o · 3 ^l
179	7 · 9 · 5 ^t · 11 ^{5t} · C ^c	11 ^t · 9 · 7 · 5 ^t · C ^c	o · θ · r · 1 ^t · 2 ^l · 3 ^t	o · θ · r · 1 ^t · 2 ^l · 3 ^t
180	7 · 7 · 5 · 5 · C ^c	11 · 9 · 7 · 5 · C ^c	o · o · o · o · 3 ^u	o · o · o · 2 ^l · o
181	7 · 5 · 5 · 1 · C ^c	7 · 5 · 5 · 3 · C ^c	H · o · o · o · 3 ^l	o · o · o · o · 3 ^l
182	7 ⁸ · 5 ⁶ · 5 · 3 · C ^c	9 · 7 · 5 · 5 · C ^c	o · o · o · o · 3 ^l	o · o · o · o · 3 ^l
365	10 · 8 · 6 · 3 · P	11 · 8 · 7 · 5 · C ^o	o · o · o · o · o	o · o · o · o · o

NOTE.—The numerical exponents signify possible alternative interpretation. *t* signifies a lower triradius, either in the course of a line or occurring in the formation of a pattern. *r* means that a pattern is rudimentary.

or 66⅓ per cent., while in this set of Negroes there are 37 out of 48, or 77 per cent. It would be of great value could the proportions quoted here be found to obtain universally among these races, and in spite of the small number of individuals from which these statistics are deduced, since they seem to rest upon so general a set of characters, and since the difference of percentage is so considerable, I am inclined to think that some such relation will be found to obtain in general. The establishment of such a point, however, demands the compilation of data from many hundreds, if not thousands, of individuals known to be of pure blood, and in this first paper upon the subject the main object is to inquire *whether distinct racial differences do exist, rather than to attempt to establish them upon such scanty data.* Regarding the relative tendency to vary in the two hands, it seems that here, as in the other races dealt with, the left is considerably more variable than the right. In these 24 different formulæ

13 are found in left-hands alone and 6 in the rights alone, while 5 are common to both. In 20 Maya formulæ 10 were found in the lefts alone, 6 in rights alone, while 4 were common; and in 62 white formulæ the figures are 23 for the lefts alone, 14 for rights alone, and 25 for both.

TABLE XIII.—Occurrence of Main Line Formulæ in Negro Hands.

FORMULÆ.	L.	R.	BOTH.	FORMULÆ.	L.	R.	BOTH.
6·5·5·3	1	0	1	9·7·5·2	0	1	1
7·5·5·1	1	0	1	9·7·5·3	0	1	1
7·5·5·2	1	0	1	9·7·5· $\frac{1}{2}$	1	0	1
7·5·5·3	3	2	5	9·7·5·5	1	4	5
7·5·5·5	3	2	5	9·8·5·5	1	0	1
7·7·5·5	3	0	3	9·9·5·5	1	1	2
7·8·5·3	1	0	1	10·8·6·3	1	0	1
7·9·5·5	1	0	1	10·9·6·5	1	0	1
7·9·5·11 ⁵	1	0	1	11·8·7·5	0	1	1
7·9·7·5	0	2	2	11·9·7·5	1	6	7
8·6·5·3	0	1	1	11·10·8·5	1	0	1
8·6·5·5	0	3	3				
9·7·5·1	1	0	1	Totals.	24	24	48

Formulæ occurring in lefts alone, 13. Formulæ occurring in rights alone, 6. Formulæ common to both, 5.

The abnormally large proportion of occurrence in the right hand of the highest formula, 11·9·7·5, seen in both whites and Mayas, occurs here also, and in fact in so nearly the same proportion in all as to indicate strongly the presence of a general law. Thus in 24 right palms this formula occurs 6 times, or exactly 25 per cent., and in left-hands but once, or approximately 4 per cent. For 200 palms of the white race the corresponding figures are: rights 22 per cent., lefts 4 per cent.; and for 42 Maya palms, 25 per cent. and 0. In this vastly greater success of the right hand to perfect what has been shown to be in man the position of greatest physiological advantage for the friction ridges (Miss Whipple, 1904), we are forcibly reminded of the doctrine of USE-INHERITANCE, since all the races under discussion are right-handed, and since the degree of success attained is in all cases practically the same. This is but one of numerous instances that are constantly coming up in the investigation of friction ridge configuration, all suggesting the great applicability of this study for the solution of questions of general biological interest.

The results of the consideration of the separate main lines and their terminations are given in table XIV, easily deducible from tables XII and XIII, but arranged in a more convenient form for reference :

TABLE XIV — *Frequency of Occurrence of the Various Terminal Positions, with Percentages (Negroes).*

TERMINI	LINE D				LINE C			
	L	R	Both	% (both)	L	R	Both	% (both)
1	—	—	—		—	—	—	
2	—	—	—		—	—	—	
3	—	—	—		—	—	—	
4	—	—	—		—	—	—	
5	—	—	—		9	4	13	27+
6	1	—	1	2+	—	4	4	8.3+
7	14	6	20	41.5+	6	6	12	25
8	—	4	4	8.3+	3	1	4	8.3
9	5	7	12	25	5	9	14	29+
10	2	—	2	4+	1	—	1	2+
11	2	7	9	19—	—	—	—	

TERMINI	LINE B				LINE A			
	L	R	Both	% (both)	L	R	Both	% (both)
1	—	—	—		2	—	2	4+
2	—	—	—		1	1	2	4+
3	—	—	—		6	4	10	21—
4	—	—	—		1	—	1	2+
5	20	15	35	73—	13	19	32	66.6+
6	2	—	2	4+	—	—	—	
7	1	9	10	21—	—	—	—	
8	1	—	1	2+	—	—	—	
9	—	—	—		—	—	—	
10	—	—	—		—	—	—	
11	—	—	—		1	—	1	2+

Table xv gives a comparison of the final results with those obtained from Mayas and whites (see also table v, and table II in appendix), and is thus the most important of the three in pointing out the amount of racial difference, and the extent to which one can use the main lines and their termini as ethnological criteria.

From this we may deduce the following results, which are to be considered the final results of the present paper in regard to main lines, since the prints of Chinese and other races which I possess are too few to present in tabular form :

Line D: The position (7) for this line is a marked Negro characteristic, especially as compared with the white race; over 41 per cent., as compared with 11 per cent. For the latter race the

higher positions are especially characteristic, positions (10) and (11) together receiving more than half, as contrasted with 23 per cent. in the Negroes. The characteristic Maya position is (9), 36 per cent., as contrasted with 25 per cent. in both whites and Negroes. Position (10) is very unusual in Negroes, and position (11) in both Negroes and Mayas is about half as common as in whites.

TABLE XV.—*Comparison of the Main Line Positions in Tables V and XIV.*

TERMINI	LINE D			LINE C		
	Maya	White	Negro	Maya	White	Negro
1	—	—		—	—	
2	—	—		—	—	
3	—	—		—	—	
4	—	—		—	—	
5	—	—		24—	8.5	27+
6	—	—	2+	7+	11.5	8.3
7	24—	11	41.5+	14+	33	25
8	7+	12	8.3+	19+	15	8.3
9	36—	25.5	25	36+	26.5	29+
10	19+	13.5	4+	—	5	2+
11	14+	38	19—	—	.5	

TERMINI	LINE B			LINE A		
	Maya	White	Negro	Maya	White	Negro
1	—	—		16+	1	4+
2	—	.5		9+	9.5	4+
3	—	—		21+	20.5	21—
4	—	—		—	10	2+
5	66+	47	73—	50	58	66.6+
6	19+	13.5	4+	—	—	
7	14+	33.5	21—	—	—	
8	—	5	2+	—	—	
9	—	.5		—	—	
10	—	—		—	—	
11	—	—		2+	1	2+

Line C: Position (5) is a little more common in Negroes than in Mayas, and in both is more than three times as common as in the white race, in which it occurs but seldom. For this latter race, position (7) is the most frequent, and is less than half as common in the Mayas, while the Negroes stand in this particular intermediate between the two. Position (9) has been given as the Maya characteristic, but is also quite common in the other races. A complete suppression of the line seldom occurs in the Negro (8.3 per cent.), but is about twice as frequent in both Mayas and whites, the Mayas leading by a little.

Line B: In all these races the most usual position is (5), but here the Negro has the decided lead. In fact this position accounts for three-fourths of the cases, and position (7) the remaining fourth. Position (6), that is, a fusion with line D, is quite common in the Mayas, about one-fifth of the cases, while in the white race position (7) claims one-third.

Line A: In Negroes a low position is not especially common, much less, indeed, than in whites, as the latter show 41 per cent. below (5) and the former but 31 per cent. For the same positions the Maya percentage is 46, — not very different from the whites, save in the important respect that in the Mayas a large part of these low positions are (1), i. e., before the carpal triradius. Thus the true conditions in these races are better seen by comparing the total percentage of positions (1) and (2), which are in Mayas 25 per cent., in whites 10.5 per cent., and in Negroes but 8 per cent. The Negroes in this respect are actually higher than the whites, and far ahead of the Mayas. In the Negro, then, position (5) is emphatically the most characteristic.

In my first attempt at looking for racial differences the material I used was that of the Negro prints Nos. 124–129, in which, as an inspection of table XIII will show, almost every formula was either 7·5·5·5, or else one easily derived from it. This I set down at once as the Negro formula, and although my later studies have necessitated a modification of my first views as to its universality, *I still think it may be typical and would like to consider that any great aberrancy from it is due to the influence of other blood.* Whether this will be borne out by later facts or not, no one can say, but the investigation of a large number, at least 100, of the prints of the natives of the Guinea coast, collected in Africa and not too near Liberia or any white settlement, might corroborate it.

It will appear at once that any near approach to one another of lines C and D would admit of three varieties: (1) where C is below D, (2) where they meet, and (3) where C passes above D; or 7·5, 8·6, and 9·7, respectively, and thus these three forms would be practically the same. Again, the figure for line A might be 4, 3, or even 2 without practically modifying the several interrelationships, and thus the typical formula would admit of at least the following varieties:

7· 5· 5· 5·
 7· 5· 5· 3·
 7· 5· 5· 2·
 8· 6· 5· 5·
 8· 6· 5· 3·
 8· 6· 5· 2·
 9· 7· 5· 5·
 9· 7· 5· 3·
 9· 7· 5· 2·

These present a different aspect when written, but might be hardly distinguishable from one another in an actual print. In the 48 Negro hands under inspection these formulæ represent 27 of them, or 56.2 per cent., while in the 42 Mayas (not admitting any case of position 1 for line A) there are 15, or 35.6 per cent., and in 200 whites, making the same reservation, yet admitting such a form as 7·5·3·2·, 7·5·5·4·, etc., there are 73, or 36.5 per cent. This large occurrence in the Negroes (56.2 per cent.) as contrasted with the 35.6 per cent. and 36.5 per cent. of the other two races makes the hypothesis advanced above appear rather probable. Further investigation in this direction will be awaited with great interest.

In the carpal region a parting instead of a triradius is met with 7 times in the 48 hands, or 14.6 per cent., about as in the Mayas and much less than in the whites. The two most characteristic forms of triradius are the centrally placed one, 43.8 per cent., and the one situated near the outer margin, 33 $\frac{1}{3}$ per cent., both with quite a little carpal area below them. The very low position so common in Mayas does not seem to occur.

The pattern formulæ given in table XII furnish the data used in table XVI, which gives the occurrence of each type of pattern in each hand, and the percentage in each case, as well as the percentages of Mayas and whites copied from table VII for ease of comparison. From this it will be seen that *both hypthenar and thenar patterns are of infrequent occurrence, this loss being more than made up by the almost universality of one or the other type of pattern on the 3d palmar area.* The percentage of occurrence of a loop pattern on the second area, caused by a recurving of line C to the inner side, is singularly constant in all three races, 33 $\frac{1}{3}$, 34, and 37 per cent., respectively.

TABLE XVI.—*Occurrence of Patterns in Palm (Negroes) with Comparison of Mayas and Whites.*

DESIGNATION OF PATTERN.	NEGRO (48).				MAYA (44).	WHITE (100).
	L.	R.	Both.	%	%	%
Hypothenar	4	3	7	14.6	4.5	41
Thenar (up and down)	5	4	9	18.7	50	7
1 (triradius)	1	2	3	6.2	4.5	2
2 (triradius)	0	0	0	0	0	1
2 (loop)	7	9	16	33.3	34	37
3 (triradius)	9	8	17	35.4	29.5	15
3 (loop)	13	13	26	54.1	29.5	44
Total. ¹	39	39	78	222.3	152	147

¹ Here, as in table VII, the totals have little value, but serve to show the relative occurrence of patterns in the various races.

In the third area the false or loop pattern is much commoner than the true one formed by means of a triradius, as is also true in the white race, but in the Mayas the two are exactly equal in occurrence. The total number of Negro hands on which the third area has a pattern is not quite 89.5 per cent., the number obtained by adding the percentage of occurrence of each type as given above, since in a few cases both types appear simultaneously, but the percentage is not far out of the way and may be safely quoted at 85 per cent., as contrasted with 59 per cent. in both Mayas and whites, *thus establishing it as a Negro characteristic.*

Summary of Negro Palm Characteristics.

- (a) *Main lines*: An overwhelming percentage of occurrence of the lower formulæ, but without the especially low position of line A, characteristic of the Mayas. The commonest formulæ are 7·5·5·5·, 8·6·5·5·, and 9·7·5·5·, and various slight modifications of them, representing 56.2 per cent. of the 42 cases investigated, while in both Mayas and whites the proportion is 35–36 per cent. Correspondingly the higher formulæ (those beyond 10.6) are conspicuous for their infrequency. (Cf. table XIII with table I of the appendix.)
- (b) *Carpal area*: A triradius is almost constant, about as in the Mayas, the two most characteristic forms being the central and lateral. A well-defined carpal area is usually present, and the very low position of the triradius, rendering the area obsolete, so common in the Mayas, is of infrequent occurrence.

(c) *Patterns*: Correlated with the occurrence of the lower formulæ a loop pattern on area 3 is very common, since position (7) for lines D or C, or the fusion of the two, would produce it. Since, as it happens, a genuine (triradius) pattern occurs on the same area in more than a third of the cases, sometimes indeed side by side with a false or loop pattern, it results that area 3 is seldom without one or the other type (85-90 per cent.). This brings the total of pattern occurrences far beyond that in the other races examined, although, as a matter of fact, the other patterns are considerably less frequent than in the whites or Mayas. Hypothenar and thenar are of about equal occurrence, but the former is but a third as frequent as in the whites, and the latter less than two-fifths as frequent as in the Mayas.

Soles.—As material for this investigation I have sole prints of all the Negroes given in table XI, with the exception of No. 125, making a total of 23 individuals. Of these the sole characters are shown by means of descriptive formulæ in table XVII from which the actual occurrence of each character, with their percentage values, may be easily deduced.

TABLE XVII.—*Sole Formulæ of 23 American Negroes.*

CAT. No.	SOLE FORMULÆ—LEFT					SOLE FORMULÆ—RIGHT				
124	B	.5+3	.Cl	.+1	.—	W ^{bs}	.+3	.Cl	.+1	.—
126	W ^d	.OL	.O	.Cl ^t	.—	W	.O	.O	.Cl ^t	.—
128	BC	.+3	.Cl	.+1O	.H	BC	.Cl	.13	.O	.H
129	BC	.+3	.Cl	.+1O	.—	BC	.+3	.Cl	.+10	.—
130	W ^{bd}	.O	.Cl ^t	.Cl ^t	.H	W ^{bds}	.Cl ^p	.5	.Cl	.H
166	W ^d	.O	.O	.O	.H	W ^{aos}	.O	.O	.O	.—
167	W ^{ds}	.+3	.Cl+3	.+1	.H	A	.+3	.Cl	.+1	.—
168	W	.O ^a L	.Cl	.Cl ^t	.—	W	.5	.Cl ^t	.Cl	.—
169	A	.O ^a	.Cl ^v	.O	.H	A	.O	.O	.O	.—
170	AC	.O	.O	.O ^v	.—	AC	.O ^a	.O	.Cl ^t	.H ^r
171	W ^d	.OL	.OC ^t	.O	.H	W ^d	.OC ^t	.Cl ^t	.O	.H
172	W ^{os}	.O	.Cl ^v	.O	.H	W ^d	.O	.O ^v	.O	.—
173	W ^{bds}	.O	.Cl ^t	.Cl ^t	.H	W ^{bds}	.O ^a	.O ^a	.O	.H
174	W ^{bds}	.O	.O ^a	.O	.—	W ^{bd}	.O	.O ^a	.O	.—
175	BC	.+3	.Cl	.+1	.H	BC	.+3	.Cl	.+1	.—
176	B	.O	.Cl ^t	.O	.H	B	.+2	.Cl+1	.O	.H
177	B sm	.Cl ^p	.Cl	.Cl ⁵	.—	B sm	.Cl ^p	.Cl	.Cl ⁵	.—
178	W ^{os}	.OL	.O	.O	.H	A	.OL	.O	.O	.H
179	B sm	.5L	.Cl+3L	.Cl ^p +2	.H]	B sm	.+3L	.Cl	.+1	.H
180	B sm	.+3L	.+3ClL	.+1	.—	B ^{ws}	.Cl ^p L	.ClL	.O	.—
181	A	.O	.O	.O	.—	A	.O	.O	.O	.H
182	W ^d	.OL	.O ^v	.O ^a	.H ^r	B ^w	.O+3	.Cl	.+1O	.H ^r
365	W ^{dsp}	.O	.O	.O	.—	W ^{dsp}	.O	.O ^v	.O	.—

TABLE XVIII.—*Showing the Occurrence of Special Characters in the Soles of Table XVII.*

Characters	ACTUAL FIGURES				PERCENTAGES ¹			
	Area 1	Area 2	Area 3	Total	Area 1	Area 2	Area 3	Total
Open areas [O]	27	19	27	73	58.7	41.3	58.7	52.9
Closed areas [C]	6	26	11	43	13.1	56.5	23.8	31.1
Confluent areas [+]	13	4	13	30	28.3	8.7	28.3	21.7
Upper loop [L]	10	3	0	13	21.7	6.51	0	9.4
Open outward [5]	3	1	2	6	6.51	2.17	4.34	4.34

From a comparison of this table with table x, in which are collected the corresponding data from whites and Mayas, there may be deduced the following facts, more or less important as Negro characters :

The proportion of open areas, 52.9 per cent., lies between the 62.8 per cent. of the whites and the 23 per cent. of the Mayas ; and that of the closed areas is the same as in the whites (31.1 vs. 31.7 per cent.). The figures for the separate areas show that in the Negroes areas 1 and 3 are equally apt to be open, while in whites and Mayas area 3 shows a much stronger tendency in this direction than area 1. As in the other races, area 2 is the most often closed, the tendency being almost that of the whites (56.5 vs. 55.7 per cent.). The tendency toward the fusion of areas is intermediate between Mayas and whites, the three sets of percentages of Mayas, Negroes, and whites respectively being 34.6, 21.7, and 12.8 per cent. As in the other cases, areas 1 and 3 are usually the ones that fuse. The figures for the occurrence of an upper loop are in close accord with those of the other races, and seem to emphasize a general human tendency beyond the influence of race. Areas that open outward are a little more frequent than in the white race, but not nearly so common as in the Mayas, doubtless owing to the infrequency of the large lower triradius, characteristic of the Mayas.

The deductions thus far are of a negative character, and do not serve to point out any trait especially distinctive of the Negro race. The tendency to the approximation of, or in numerous instances the almost complete identity with, the proportions of the whites, may suggest the almost universal admixture of blood, not only ad-

¹ For the separate areas the percentages are calculated on a basis of 46, the number of soles ; for the totals the basis is 138, the number of areas (46×3).

mitted as a general fact, but shown by unmistakable bodily characteristics in many of the individuals under present examination. What might be the results from prints taken from the native race in Africa can be only surmised, but the results thus far render such an investigation of great importance.

A far more hopeful set of characters, in which positive results may be obtained, is that of the hallucal pattern. Remembering the statistics concerning Mayas and whites, especially the almost universal occurrence of the A type in the former and the moderate frequency of the W type in the latter, it is of much interest to note the following comparison of statistics :

TABLE XIX.—*Comparison of Hallucal Patterns in Negroes, Mayas, and Whites.*

TYPE	ACTUAL FIGURES			PERCENTAGES ¹		
	Negro	Maya	White	Negro	Maya	White
W	22	3	38	47.8	11.5	38
A	6	21	49	13.1	80.7	49
B	10	1	10	21.7	3.8	10
C	0	0	1	0	0	1
AC	2	0	1	4.34	0	1
BC	6	0	1	13.1	0	1
AB	0	1	0	0	3.8	0

Here will be seen in the Negroes two positive characters and one negative one, namely, the high percentage of occurrence of the W and B types, and the subordinate position held by type A. The first of these characters, the dominance of type W, shows considerable increase over the white race, where this character is quite conspicuous, and between the Negroes and the Mayas the difference is a marked one. Besides that of the percentage of occurrence, type W differs in the three races in another way, and that is by its triradii and the formation of its cores. In the Mayas this type, when it occurs, is in its most primitive condition, with three triradii and with a core of concentric circles, while in both whites and Negroes, the outer triradius, i. e., the one between hallux and digit II, has usually disappeared (= exponent *d*). The core of the pattern in the whites is most frequently a spiral (27 out of 38); in the Mayas the primitive con-

¹ In calculating the percentages it must be remembered that the observations are based on 46 Negro and 26 Maya soles. For the whites 100 soles were taken from table IX, rejecting the last four—Nos. 236 and 237.

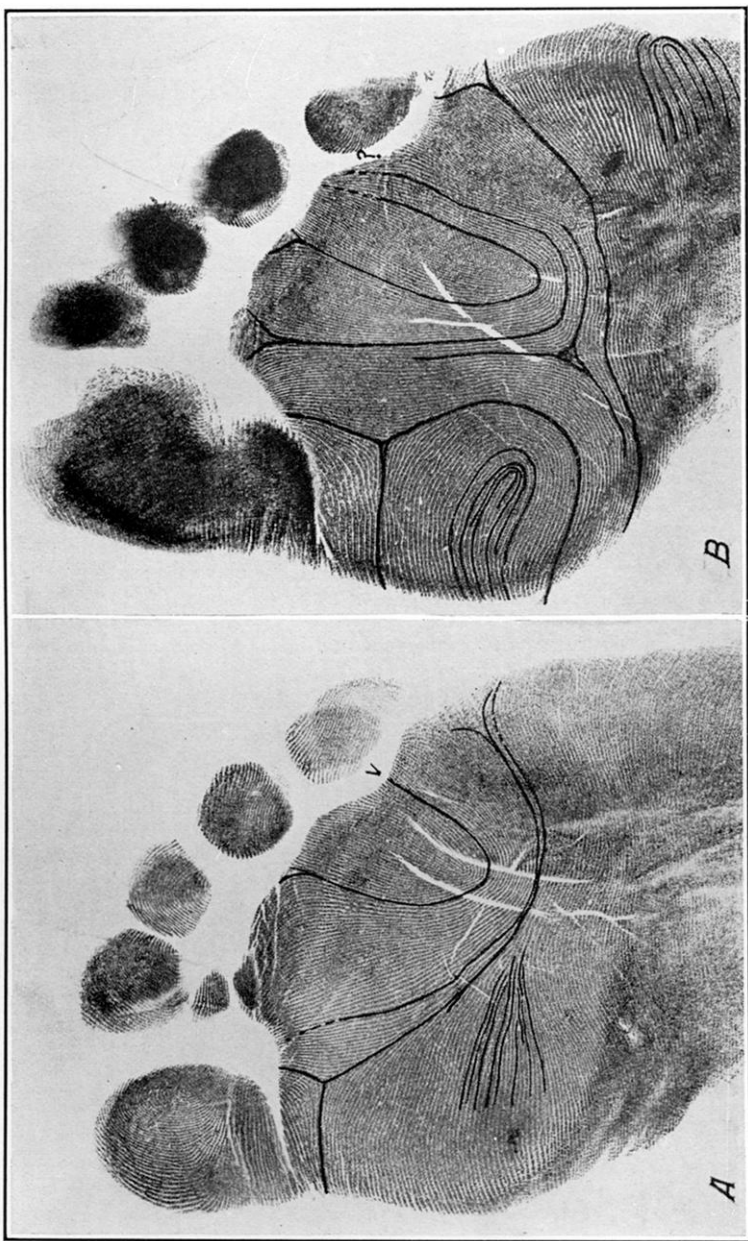
centric circles ; and in the Negroes either the latter or an S-shaped figure, seldom a spiral (2 out of 22).

The second Negro character, which is especially striking when one looks through a set of prints, is the frequency of type B, either by itself or in connection with some other change, as BC (plate xi). Out of 46 soles under discussion, B alone occurs 10 times, and in connection with C six times more, making a total of 34.8 per cent. As this type displays no conspicuous core other than a loop that is often very broad, it frequently appears as though a definite hallucal pattern were lacking, and, indeed, in my first examination of these prints, before the underlying morphological principles had been established, I characterized such cases as "no hallucal pattern." Such a phenomenon, occurring so frequently in a set of prints, cannot fail to arrest attention, and if found to be definitely characteristic of the Negro, will prove a convenient element in diagnosis of race.

A hypothenar pattern (H) seems almost as common in the Negroes as in the whites ; and of the calcar pattern, occurring in the whites at the ratio of about 1 per cent., no trace is found in the 46 Negro soles.

Summary of Negro Sole Characteristics.

- (a) *Plantar areas* : All that can be said here is that in the usual features, such as open and closed areas, etc., the Negroes show nothing that can be considered characteristic. In some points they stand intermediate between Mayas and whites, generally nearer the latter, and in others the correspondence between Negroes and whites is almost exact, points which may be due to the infusion of white blood, which is conceded to be universal.
- (b) *Hallucal patterns* : The most frequent type is the W, the core of which is formed either of concentric circles or an S-shaped figure. The outer triradius is deficient. Type B occurs with far greater frequency than in any of the other races examined, and, through this fact as well as its conspicuous character, may be of considerable use as a racial criterion. Type A is conspicuous for its infrequency, especially as it is the dominant character in the Mayas and very common in the whites.
- (c) *Hypothenar and calcar patterns* : The hypothenar pattern occurs as frequently as in the whites ; a calcar pattern has not yet been recorded.



SOLE PRINTS OF NEGRO CHILDREN, SHOWING CHARACTERISTIC HALLUCAL PATTERNS (NATURAL SIZE)
A, Catalogue No. 175; formula: $BC \cdot + 3 \cdot Cl \cdot + 1 \cdot -$. *B*, Catalogue No. 176; formula: $B \cdot + 2 \cdot Cl + 1 \cdot O \cdot H$.

(d) No characteristic *Negro formula* can be ventured upon at present.

C. — CHINESE.

Material. — I have been able thus far to obtain but very little material representing the Mongolian race, my entire collection being limited to prints of nine Chinese, of but four of whom I possess both palm and sole prints (table xx).

TABLE XX.—*List of Prints of Chinese.*¹

CAT. NO.	NAME	CAT. NO.	NAME
299	Chung Gip	315	Quan Dong
300	Quan Sing	316	Chin Kay
301	Quan Gea	317	Hay Wah
302	Quan Wah	318	Ung Dong
314	Wo S. Mon		

Those that I have are, for the greater part, extremely well taken, and are due to the efforts of Mr Chung Gip of Springfield, Mass., whom I wish to thank in this connection.

TABLE XXI.—*Descriptive Formulæ of the Palms of Nine Chinese.*

CAT. NO.	MAIN LINE AND CARPAL FORMULÆ		PATTERN FORMULÆ	
	Left Palm	Right Palm	Left Palm	Right Palm
299	7.5.5.2.P	8.6.5.3(?)	H.0.0.0.3 ¹	H.0.0.0.3 ¹
300	7.5.5.5.C	8.6.5.5.P ^{bt}	0.0.0.0.3 ¹	0.0.0.2 ^t .3 ¹
301	7.5.5.3.C ^o	8.6.5.3.C ^o	0.0.0.0.3 ¹	0.0.0.0.3 ¹
302	10.8.6.2.C ^o	illegible	0.0 ^{tr} .0.0.0	illegible
314	5 ^t .5.5.5.P	10.8.6.5.C ^o	H.0.0.0.3 ^t	0.0.0.0.3 ^{tr}
315	9.7.5.3.P	9.8.5.3.P	0.0.0.0.3 ¹	0.0.0.0.0
316	11.8.7.2.C ^o	11.8.7.5.C ^o	0.0.0.0.0	0.0.0.0.0
317	7.5.5.1.C ^o	illegible	0.0.0.0.3 ¹	illegible
318	10.7.6.3.C ^o	10.7.8.5.(?)	H.0.0.0.3 ¹	0.0.0.0.3 ¹

TABLE XXII.—*Descriptive Formulæ of the Soles of Four Chinese.*

CAT. NO.	LEFT SOLE		RIGHT SOLE	
299	A ^w	.O.O.O.—	A.O.O	.O.—
300	W ^{adsp}	.O.O ^v .O.—	W ^d .O.O ^v	.O.—
301	A	.O.O ^v .O.—	B.O.O ^v	.O.H
302	A ^w	.O.O ^v .O.—	A ^w .O.OCl ^t	.O.—

From the descriptive formulæ of these prints (tables XXI and XXII) several points may be obtained, *important in relation to the*

¹ Collected by Mr Chung Gip.

² Palms and soles both; the others are represented by palms alone.

general question of the paper, that of the racial value of the markings. It will be noticed that the formulæ of the palms are in no way different from those of the other races studied; that, for example, the "Negro formula" 7·5·5·5· occupies a prominent place, and that the higher formulæ also are well represented. In the patterns of the palm, both thenar and hypothenar occur and are of the typical form, showing nothing unusual save perhaps in the single instance of No. 299 right, where the hypothenar pattern takes an unusually low position, yet one that can be duplicated among my collection of hand-prints of the white race.

The formula 5·5·5·5· (314 left) is indeed unique, being the first instance of its kind yet noted, but the singular condition is due to a coincidence of a third lower triradius and an open line C at the same time, thus causing line D at about the middle of the palm to bend sharply back upon itself. The condition is singular, but it may be doubted if it is a distinctively Chinese character, since the remainder of the prints bear such a familiar appearance. *An important point may be noted in the soles: the almost universality of open areas, and if this can be established by other prints as a Chinese or Mongolian character, it will be a point of great ethnological importance.* However, three of the four individuals investigated have the same surname (i. e., first name), Quan, and are probably closely related, thus giving the likelihood that the coincidence is a family rather than a racial character.

In general it may be said that the study of these few Chinese prints is of value in still further emphasizing the conclusion already reached that *the individual palm and sole characters are of no value as racial criteria, and repeat themselves, both in typical form and in all their variations, in human beings of every race thus far examined,* races representing extreme, though in no cases absolutely pure, types.

III. — GENERAL CONCLUSIONS

1. In all the races studied thus far, there is much individual variation in the palm and sole markings.

2. As a result of this a given print can be duplicated, so far as its main features are concerned, among individuals of a totally distinct race.

3. If, however, instead of a single set of prints, a large number be studied and the average occurrence of the various features obtained, these averages will be constant or nearly so for a given race. As a racial diagnostic such results will serve to distinguish peoples widely different from one another, but it is hardly probable that they will be reliable in the case of related tribes. Thus, a collection of Maya prints may be distinguished from an equal number of whites, but it may be surmised that the Mayas could hardly be distinguished from an allied Indian tribe.

4. The number sufficient to obtain reliable averages is not necessarily a large one, as it has been shown that from sets of 13 individuals similar results are obtained. The accuracy, however, increases with the number of prints employed, and, since the two hands show differences in amount of variation, it may be suggested that an ideal set for the study of the palms would consist of the left hands alone of 100 different individuals; for the soles, in the absence of knowledge concerning the relations of left and right, it would be safe to take the same.

5. The greatest amount of variation observed is that seen in the white race, formed in all probability from a vast number of original ethnic elements; and the least is that found in the Mayas, thus suggesting that the nearer one gets to a primitive race the less the amount of variation.

6. The above fact (5) suggests the hypothesis that in an absolutely pure race there may be but one general type of palmar and plantar configuration, admitting slight variations due to difference in proportion between the areas and other elements. It is greatly to be desired that prints be obtained from the purest racial stocks now living, to prove or to disprove this hypothesis.

APPENDIX

The following tables show the main-line formulæ and their relative occurrence in the palms of 100 females of the white race. They are taken from an article by the author in *Popular Science Monthly*, September, 1903, by permission of the editor, Prof. J. McKeen Cattell:

TABLE I.

FORMULÆ	L	R	FORMULÆ	L	R	FORMULÆ	L	R	FORMULÆ	L	R
$\overset{1}{1}^3 \cdot 7 \cdot 5 \cdot 5$	I	I	8·6·5·5	2	6	10· 7·6·5	3	4	11· 8·7·2	I	2
$\overset{1}{1}^3 \cdot 8 \cdot 7 \cdot 5$	I	O	8·7·6·5	O	I	10· 8·6·3	O	I	11· 8·7·3	I	O
$\overset{1}{1}^3 \cdot 9 \cdot 5 \cdot 5$	I	I	9·7·5· $\overset{1}{1}$	I	O	10· 8·6·5	I	2	11· 8·7·4	O	2
$\overset{1}{1}^3 \cdot 9 \cdot 7 \cdot 5$	O	I	9·7·5·I	I	O	10· 9·6·2	I	O	11· 8·7·5	4	3
$\overset{1}{1}^3 \cdot 10 \cdot 8 \cdot 11$	O	I	9·7·5·2	3	I	10· 9·6·3	I	O	11· 8·9·5	O	I
$7 \cdot \overset{1}{1}^3 \cdot 5 \cdot 4$	O	I	9·7·5·3	3	2	10· 9·6·4	I	I	11· 9·7· $\overset{1}{1}^H$	I	I
7·5·3·2	I	O	9·7·5·4	O	4	10· 9·6·5	2	2	11· 9·7· $\overset{1}{1}$	I	O
7·5·5·2	2	O	9·7·5·5	5	11	10·10·6·5	O	I	11· 9·7·3	2	I
7·5·5·3	6	I	9·8·5·3	4	I	10·10·8·5	O	I	11· 9·7·4	2	O
7·5·5·4	I	I	9·8·5·4	I	O	11· 7·5·3	I	O	11· 9·7·5	4	22
7·5·5·5	2	2	9·8·5·5	2	2	11· 7·5·5	I	O	11·10·8· $\overset{1}{1}$	O	I
7·9·5·3	I	O	9·8·7·5	O	I	11· 7·7·1	I	O	11·10·8·4	I	O
7·9·5·5	O	I	9·9·5·3	I	O	11· 7·7·2	I	O	11·10·8·5	I	4
7·9·5·11	I	O	9·9·5·5	2	2	11· 7·7·3	I	I	11·11·8·5	O	I
8·6·5·2	2	O	10·7·6·2	5	O	11· 7·7·4	I	O			
8·6·5·3	9	4	10·7·6·4	I	O	11· 7·7·5	8	4			

TABLE II.

TERMINUS	LINE D			LINE C			LINE B			LINE A		
	L	R	Both	L	R	Both	IL	R	Both	L	R	Both
$\overset{1}{1}^H$	—	—	—	—	—	—	—	—	—	I	I	2
$\overset{1}{1}^1$	—	—	—	—	—	—	—	—	—	2	I	3
$\overset{1}{1}^2$	—	—	—	—	—	—	—	—	—	—	—	—
$\overset{1}{1}^3$	3	4	7	—	I	I	—	—	—	—	—	—
I	—	—	—	—	—	—	—	—	—	2	O	2
2	—	—	—	—	—	—	—	—	—	16	3	19
3	—	—	—	—	—	—	I	O	I	30	11	41
4	—	—	—	—	—	—	—	—	—	8	9	17
5	—	—	—	—	—	—	—	—	—	40	74	114
6	—	—	—	12	4	16	53	41	94	—	—	—
7	14	6	20	37	29	66	29	38	67	—	—	—
8	13	11	24	15	15	30	2	8	10	—	—	—
9	23	24	47	21	32	53	O	I	I	—	—	—
10	15	12	27	2	8	10	—	—	—	—	—	—
11	32	43	75	—	I	I	—	—	—	I	I	2

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- [For a more complete bibliography of the general subject of the epidermic marking of palms and soles, see that given in the paper by Miss Whipple, cited above.]